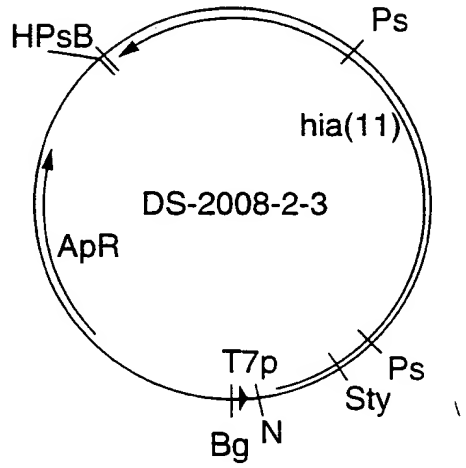
09/936362
PCT/CA00/00289

Restriction map of DS-2008-2-3, pT7 hia (11).



pT7 hia (11)

FIG.1A

FIG.1B

Oligonucleotides used to PCR amplify the full-length strain 11 *hia* gene for expression studies.

sense

```
        EcoR I Nde I
          ↓    ↓
                M  N  K  I  F  N  V  I  W  N     P                          SEQ ID NO:2
5'  GCGAATTCATATGAACAAAATTTTTAACGTTATTTGGAAT    3'          5038.SL        SEQ ID NO:1
```

antisense

```
          K  T  G  V  A  A  G  V  G  Y  Q  W  *  *                        SEQ ID NO:5
5'        AAAACAGGCGTTGCAGCAGGTGTTGGTTACCAGTGGTAATAG                3'     SEQ ID NO:4
3'        TTTTGTCCGCAACGTCGTCCACAACCAATGGTCACCATTATCTTAAGGCCTAGGCG  5'     SEQ ID NO:3
                                                  ↑    ↑
                                              EcoR I BamH I
```

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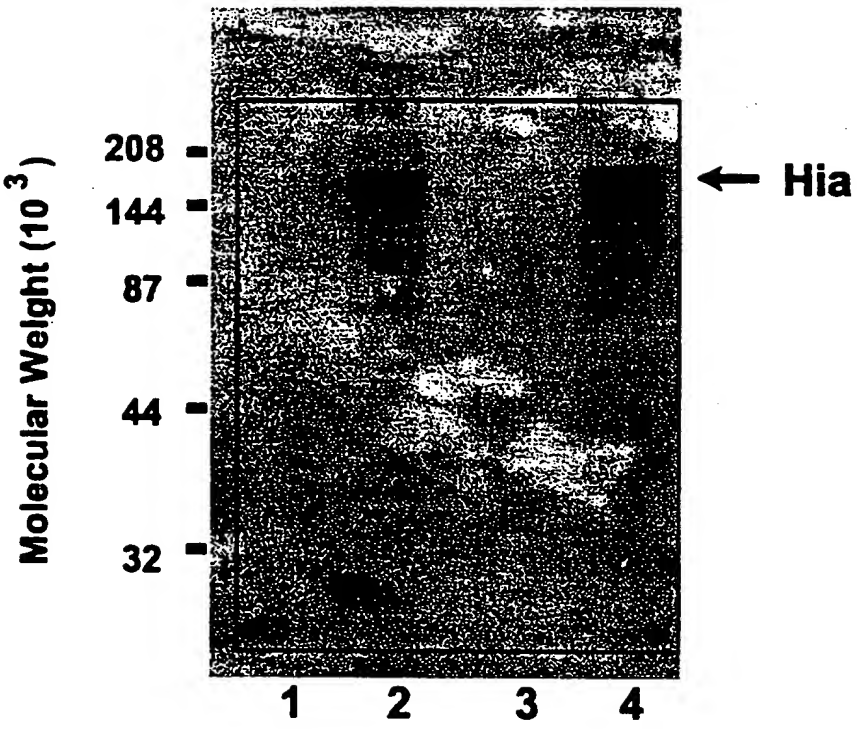
PCT/CA00/00289

FIG.2



Construction of DS-2092-1 and DS-2092-40,
plasmids containing tandem T7 hia (11) genes.

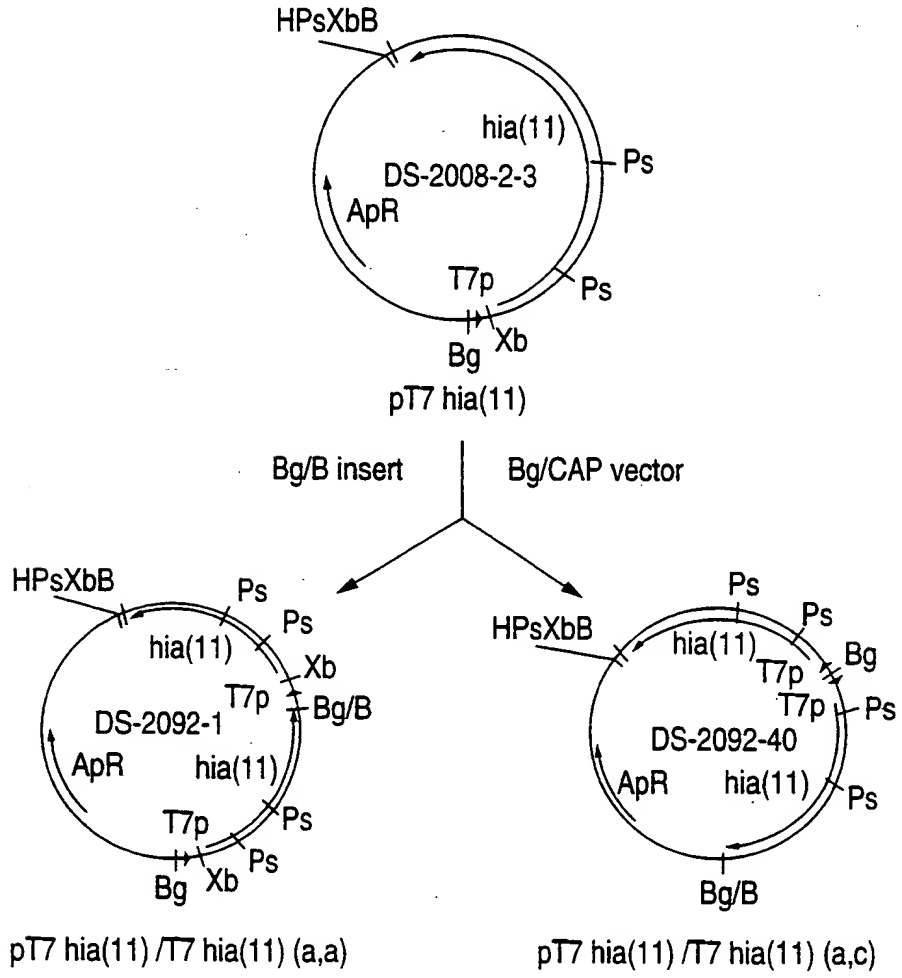


FIG.3

FIG.4

Sites for N-terminal truncations of rHia proteins.

MNKIFNVIWNVVIQIWVVSE[21]LTRTHTKCASA[33]T[33]VAVAV[38]LATLLSATVEANAN[52]TPVTNKLKAYGD (SEQ ID NO.6)

Construction of plasmids expressing truncated hia (11) genes.

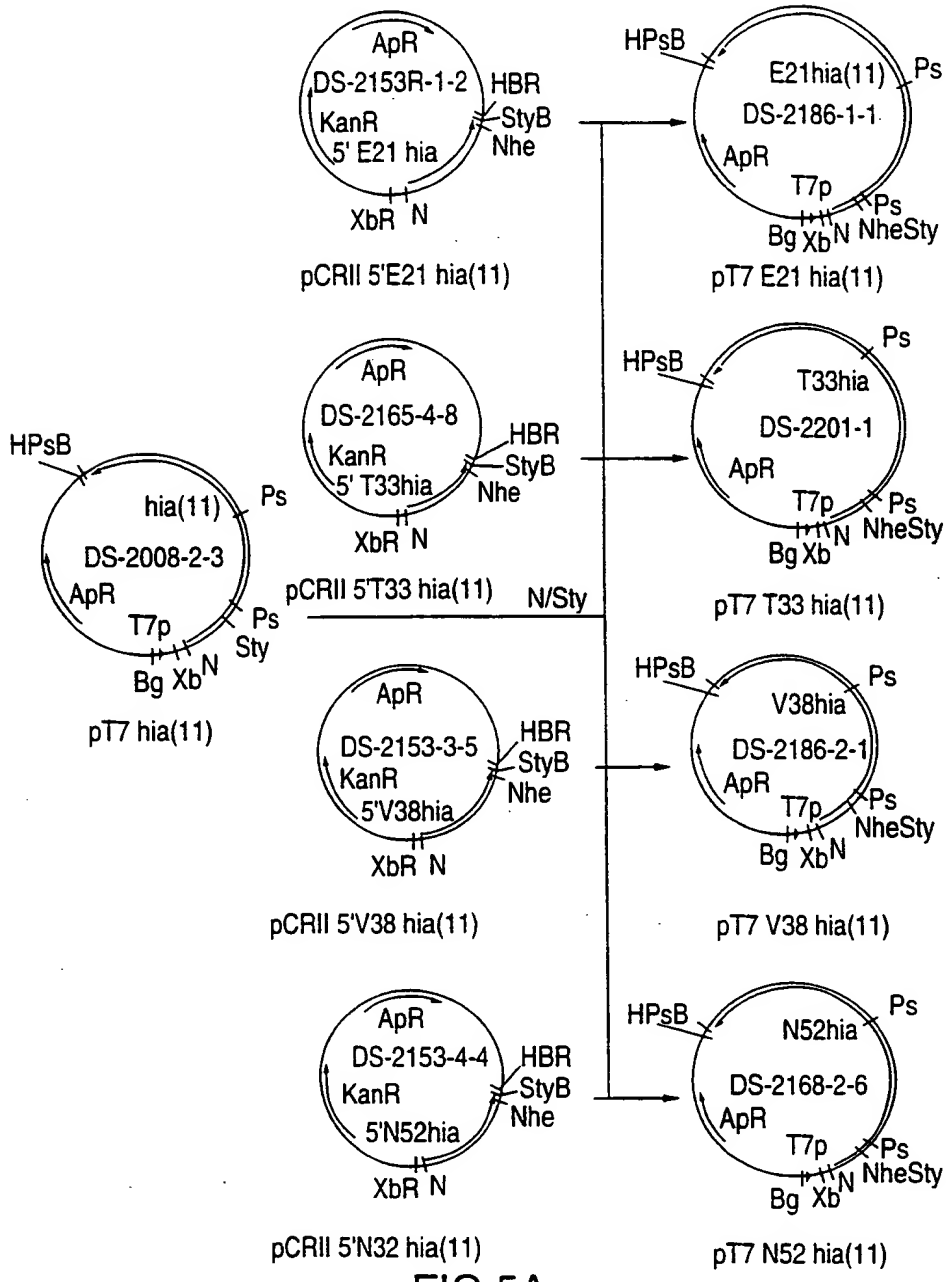


FIG.5A

FIG.5B

Oligonucleotide primers to PCR amplify truncated strain 11 *hia* genes.

E21

EcoR I Nde I

M E L T R T H T K C A

5′ GCGAATTCATATGGAACTCACTCGCACCCACACCAAATGGGCC 3′ 5524.SL

SEQ ID NO: 8
SEQ ID NO: 7

T33

M T V A V A V L A T L

5′ GCGAATTCATATGACCGTGGCGGTTGCCGTATTGGCAACCCTG 3′ 5525.SL

SEQ ID NO:10
SEQ ID NO: 9

V38

M V L A T L L S A T

5′ GCGAATTCATATGGTATTGGCAACCCTGTTGTCCGCAACG 3′ 5526.SL

SEQ ID NO:12
SEQ ID NO:11

FIG.5B'

N52

M N T P V T N K L K A

5' GGGAATTCATATGAATACTCCTGTTACGAATAAGTTGAAGGCT 3' 5527.SL SEQ ID NO:14

SEQ ID NO:13

antisense

H T I T F A L A K D L G

5' CACACCATTACCTTTGCGCTAGCGAAAGACCTTGGTGG 3' 5528.SL SEQ ID NO:17

3' GTGTGGTAATGGAAACGCGATCGCTTTCTGGAACCACCCTAGGGC 5' SEQ ID NO:16

Nhe I Sty I BamH I SEQ ID NO:15

Construction of BK-96-2-11,
a plasmid containing T7 V38 hia(11) and cer.

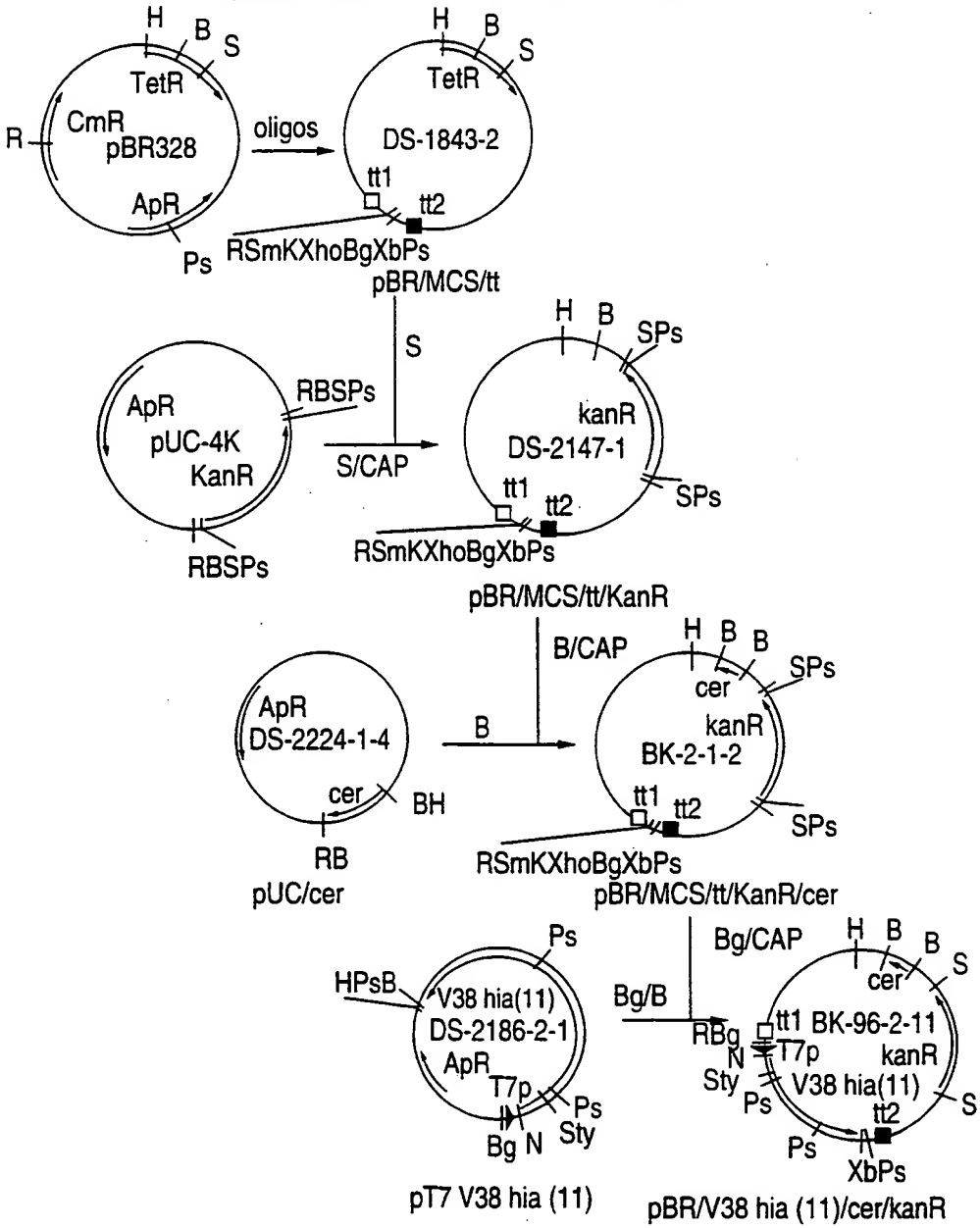


FIG.6A

FIG.6B

Oligonucleotides used to generate the multiple cloning site and transcription terminators for the expression plasmids

```
                                          R         Sm
"R"          trpA terminator              ↓         ↓      KXho   Bg Xb     ...
AATTGCAGCCCGCCTAATGAGCGGGCTTTTTTGAATTCCCGGGTA  ↓↓     ↓    ↓      ...
                                                CCTCGAGATCTCTAGAC...
   CGTCGGGCGGATTACTCGCCCGAAAAAACTTAAGGGCCCATGGAGCTCTAGAG
                                                         ATCTG...
                                          ...  Ps
                                          ...  ↓          T7 gene 10 terminator
                                          ...TGCAGATATAGTTCCTCCTTTCAGCAAAAAACCCCTCAA

                                          ...ACGTCTATATCAAGGAGGAAAGTCGTTTTTTGGGGAGTTCTGGGCAAATC

                                                          "Ps"
GACCCGTTTAGAGGCCCCAAGGGGTTATGCTAGTTATTGCTCAGCGGTGGCAGCAGCGTGCA       SEQ ID NO:50
         TCCGGGGTTCCCCAATACGATCAATAACGAGTCGCCACCGTCGTCGC             SEQ ID NO:51
```

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Construction of DS-2242-1 and DS-242-2,
plasmids containing T7 hia (33) and cer.

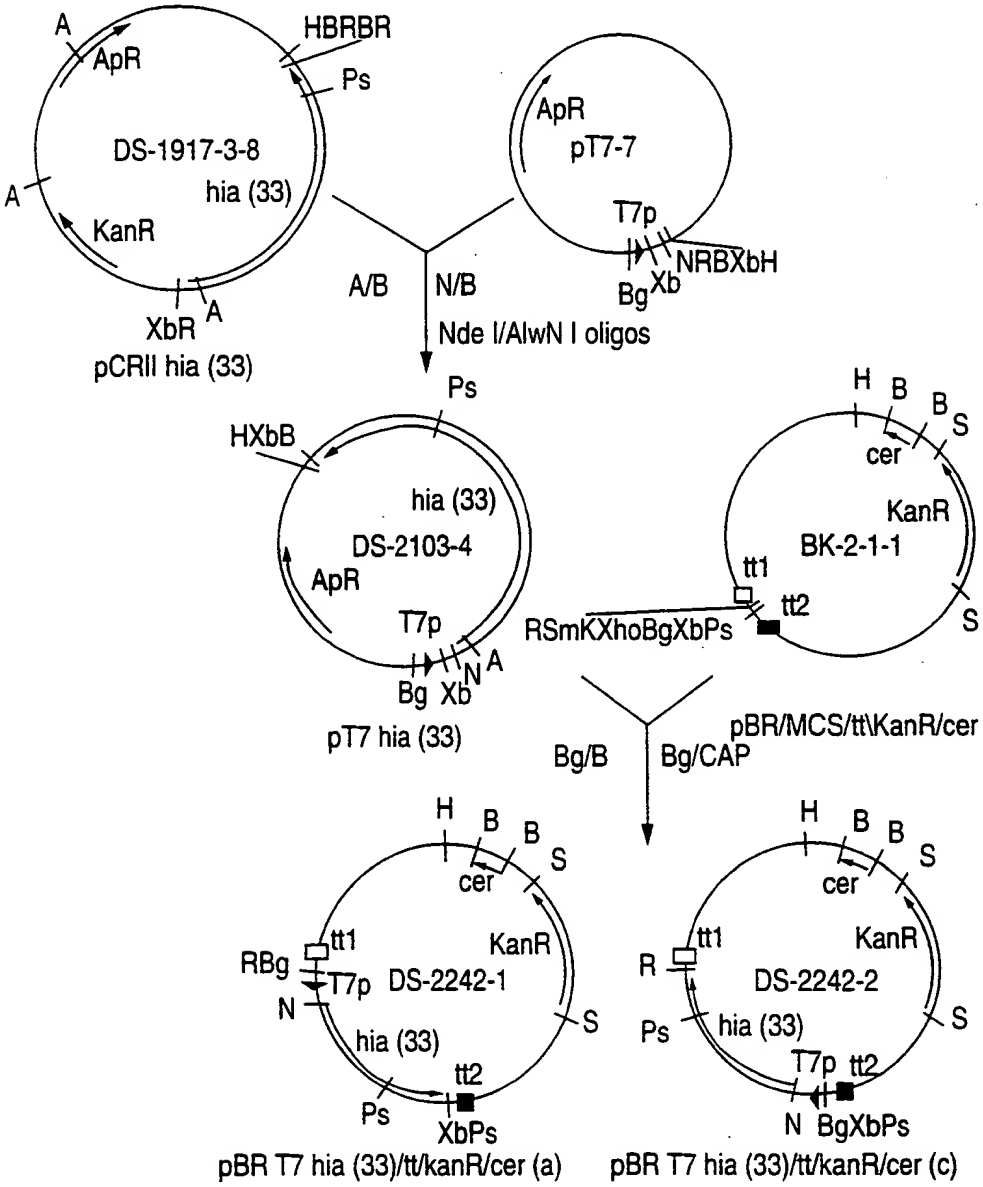

FIG.7A

FIG.7B

Oligonucleotides used to generate the 5'-end of the strain 33 *hia* gene for expression studies.

Construction of DS-2340-2-3,
a plasmid containing T7 V38 hia (33) and cer.

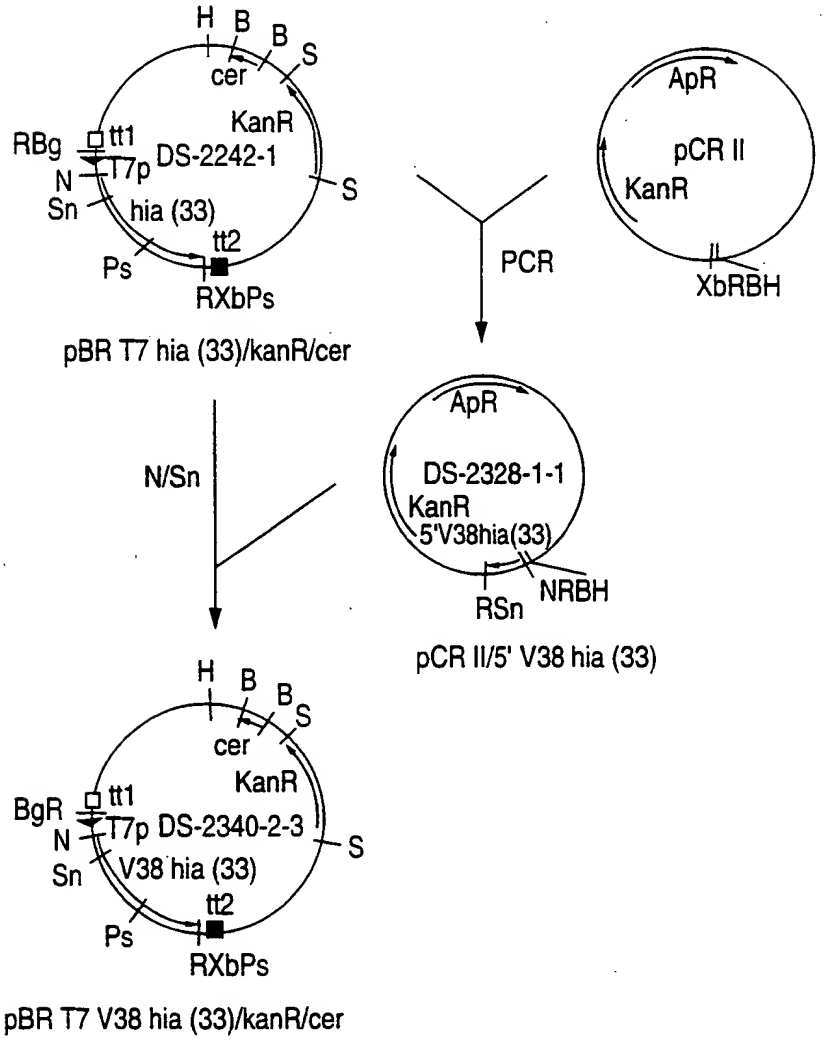

FIG.8A

09/936362
PCT/CA00/00289

FIG.8B

Oligonucleotides used to PCR amplify the strain 33 hia gene from the V38 codon to the SnaB I site.

sense

Nde I

M V L A T V L S A T SEQ ID NO:61

5′ GGGAATTCATATGGTATTGGCGACCGTATTGTCTGCAACG 3′ 6286.SL SEQ ID NO:60

antisense

SnaB I

D E T T A T V G N L R K L SEQ ID NO:20

5′ GACGAAACCACCGCAACCGTAGGCAATTTACGTAAATTGAAGCTTCG 3′ SEQ ID NO:19

3′ CTGCTTTGGTGGCGTTGGCATCCGTTAAATGCATTTAACTTCGAAGC 5′ 6287.SL SEQ ID NO:18

Construction of DS-2447-2,
a plasmid containing tandem T7 V38 hia (11) cassettes and cer.

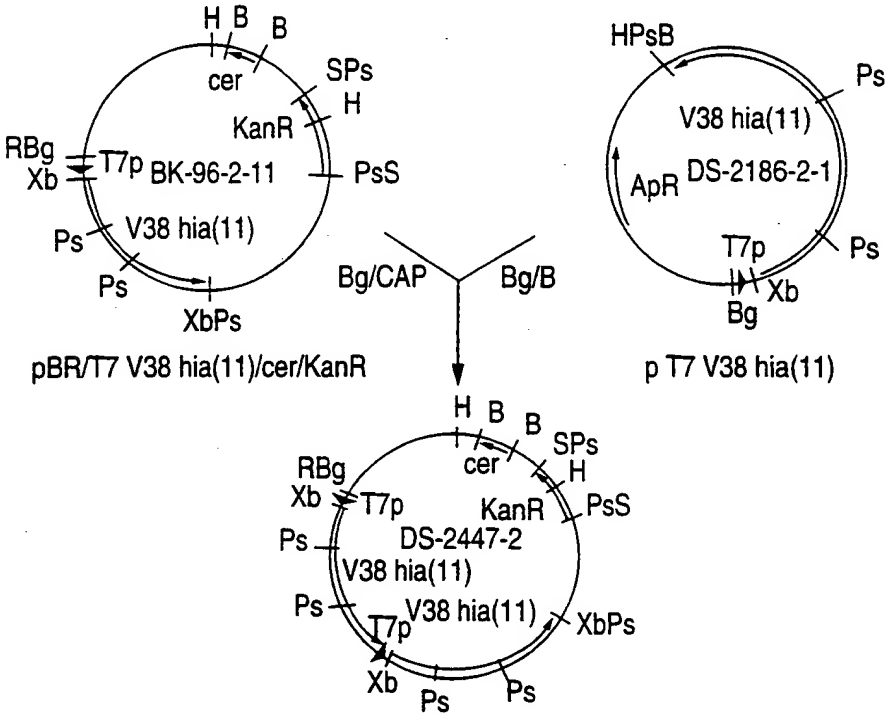

FIG.9A

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Construction of DS-2448-17,
a plasmid containing tandem T7 V38 hia(33) cassettes and cer.

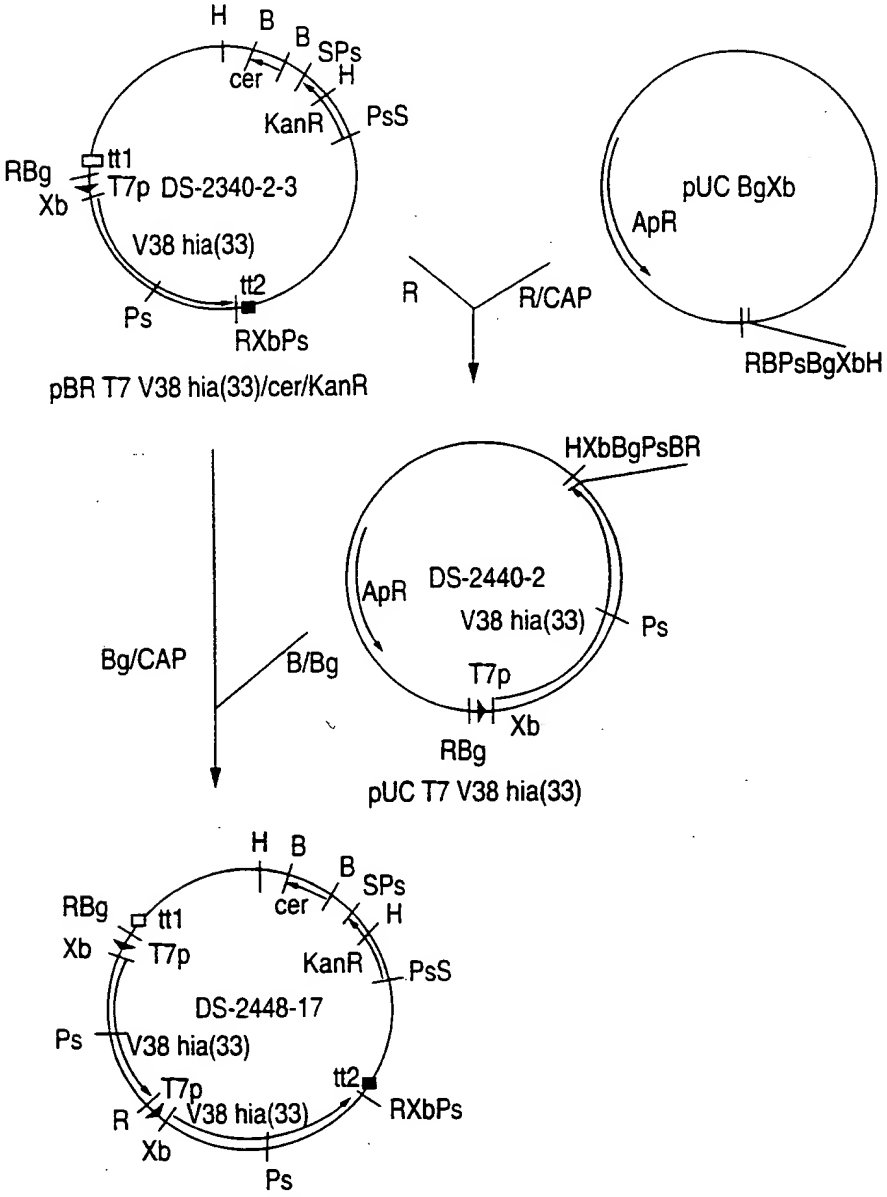
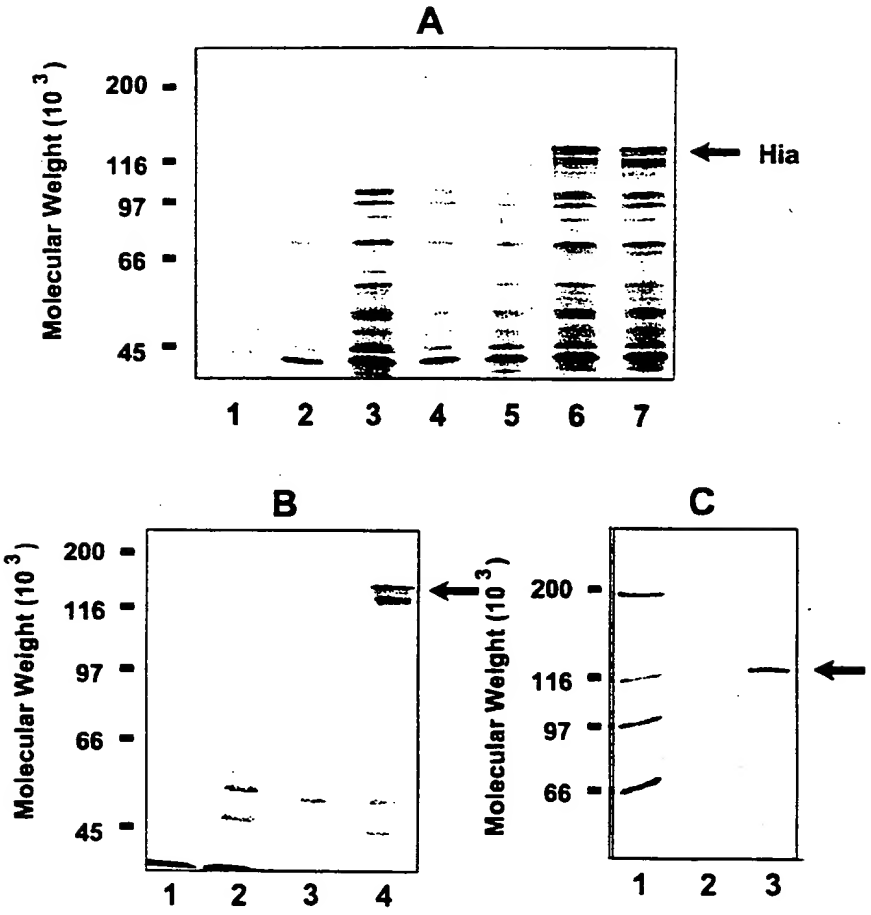


FIG.9B

FIG.10


A
Molecular Weight (10^3)
200
116
97
66
45
Hia
1 2 3 4 5 6 7
B
Molecular Weight (10^3)
200
116
97
66
45
1 2 3 4
C
Molecular Weight (10^3)
200
116
97
66
1 2 3

Purification of rHia Proteins from E. coli

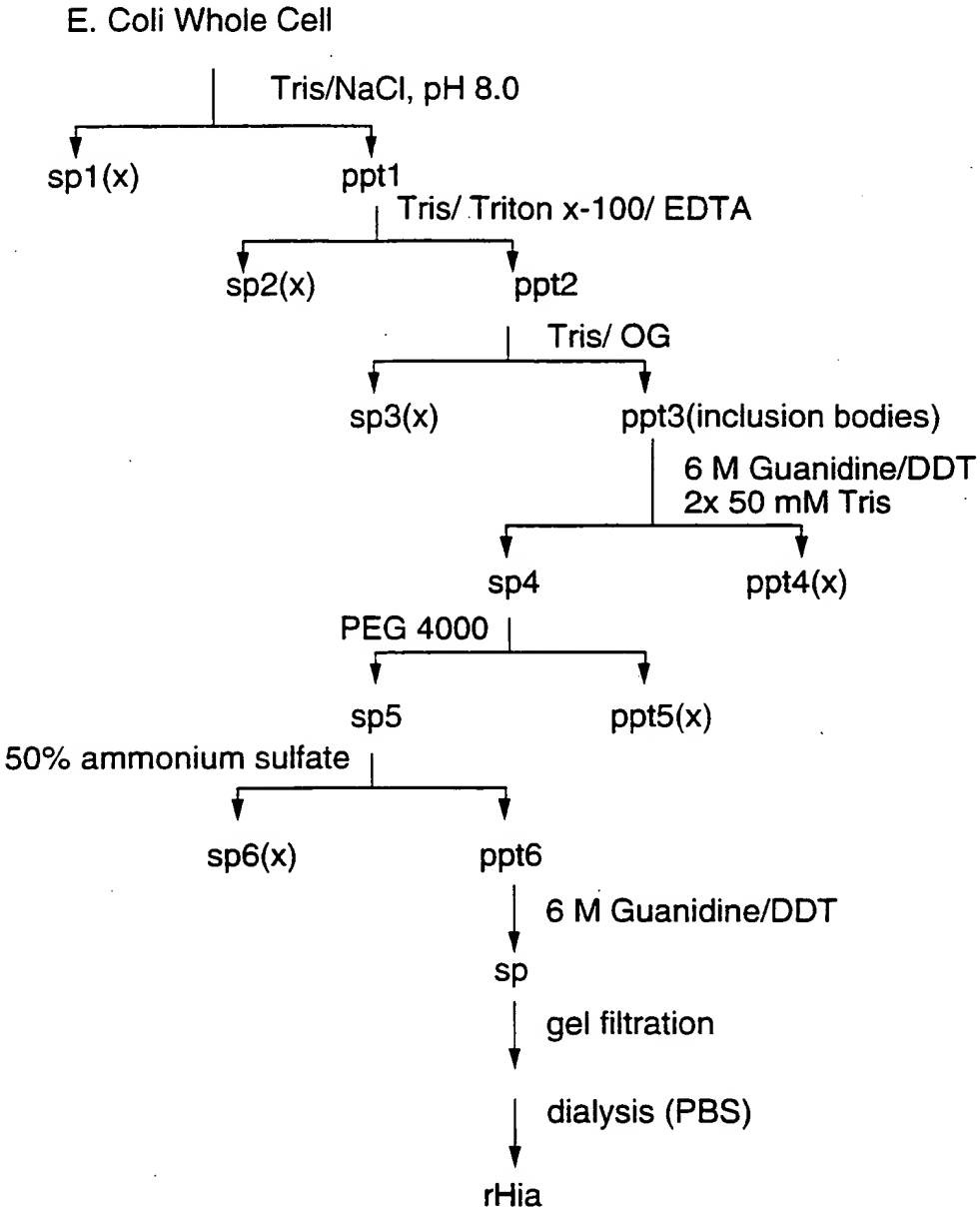
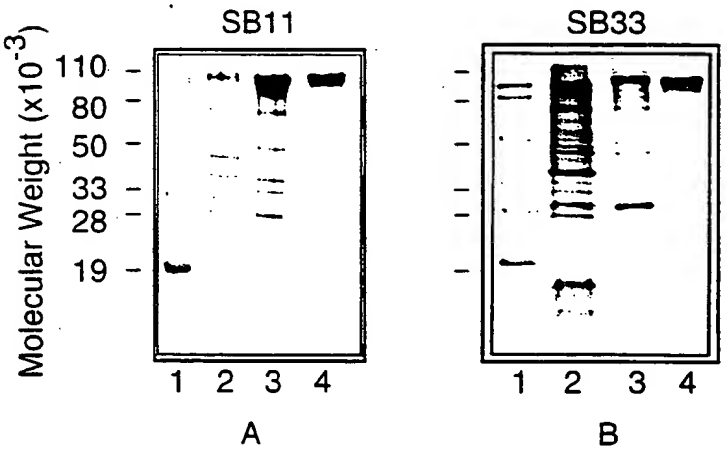


FIG.11

Purification of rHia (V38) from E. coli



1. Prestained molecular weight markers
2. E. coli whole cell lysate
3. Crude extract
4. Purified rHia protein

FIG.12

The Stability of rHia (V38/SB11)

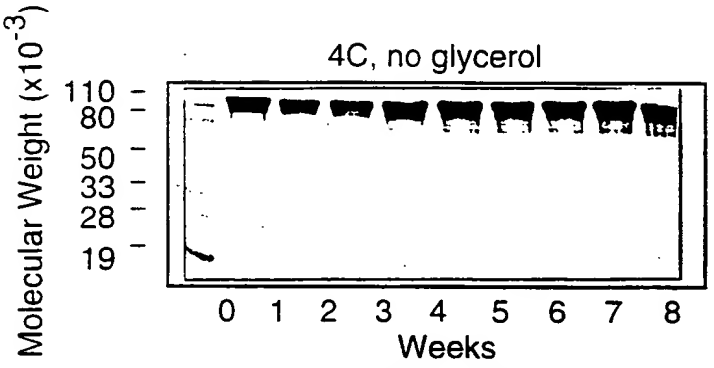


FIG.13A

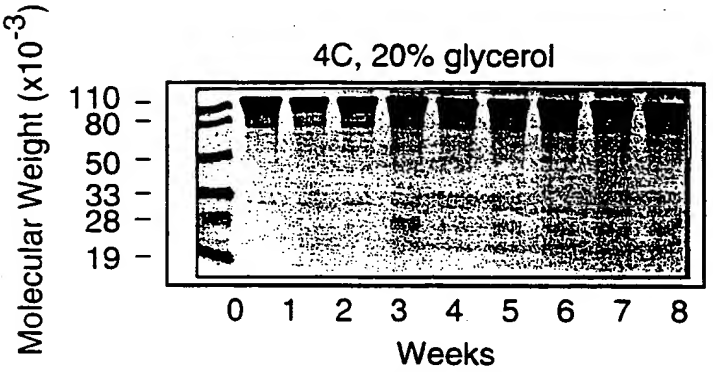


FIG.13B

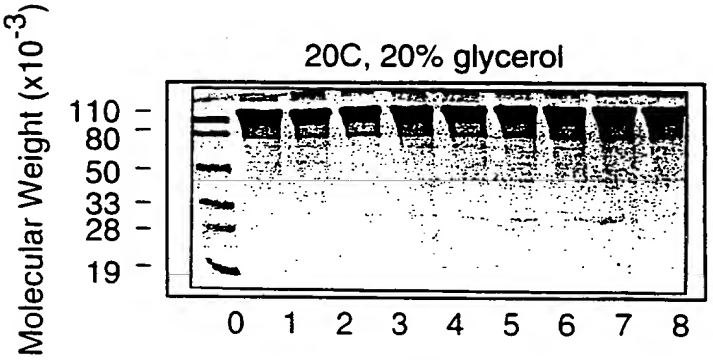


FIG.13C

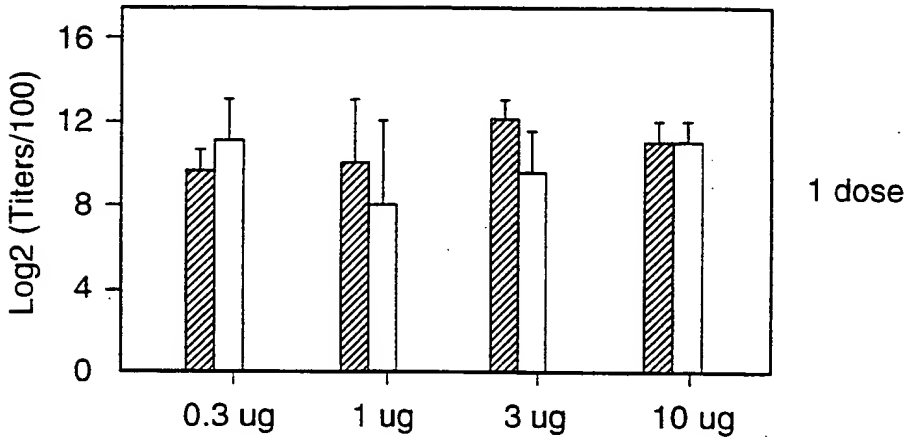


FIG.14A

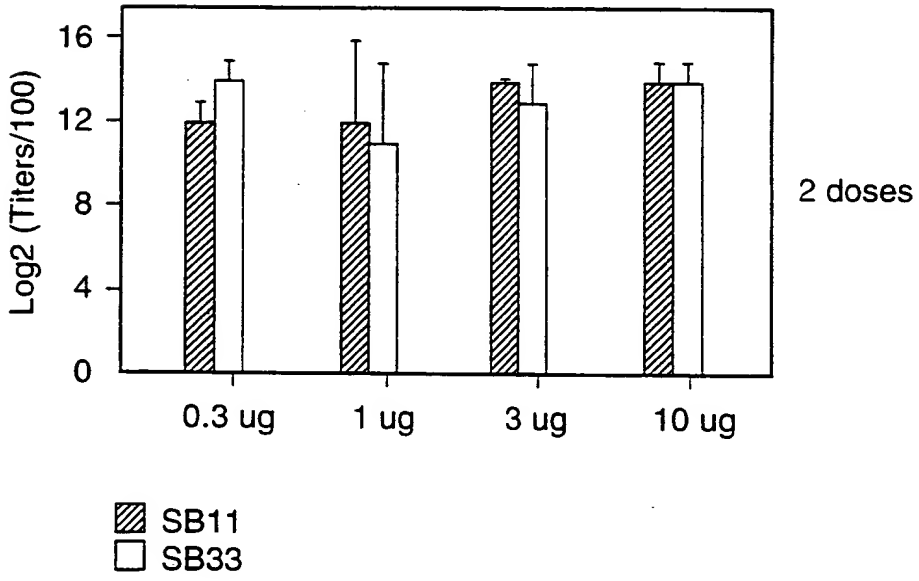


FIG.14B

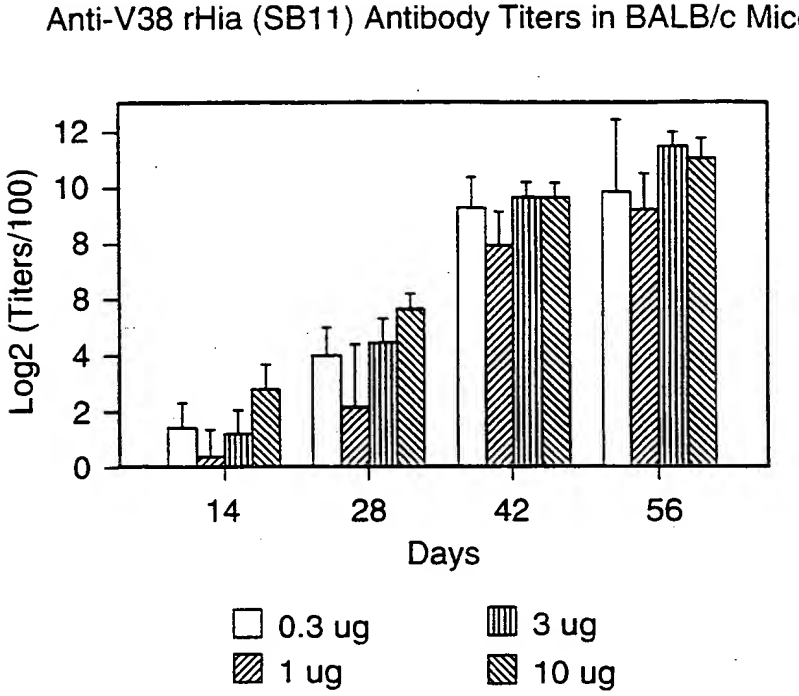


FIG.15A

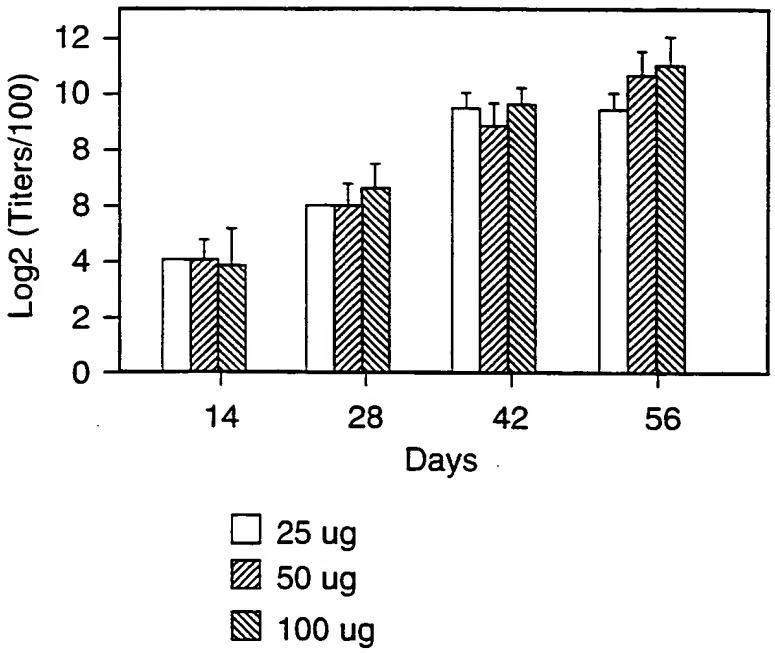

Anti-V38 rHia (SB11) Antibody Titers in Guinea Pigs
Log2 (Titers/100)
12
10
8
8
4
2
0
14
28
42
56
Days
25 ug
50 ug
100 ug

FIG.15B

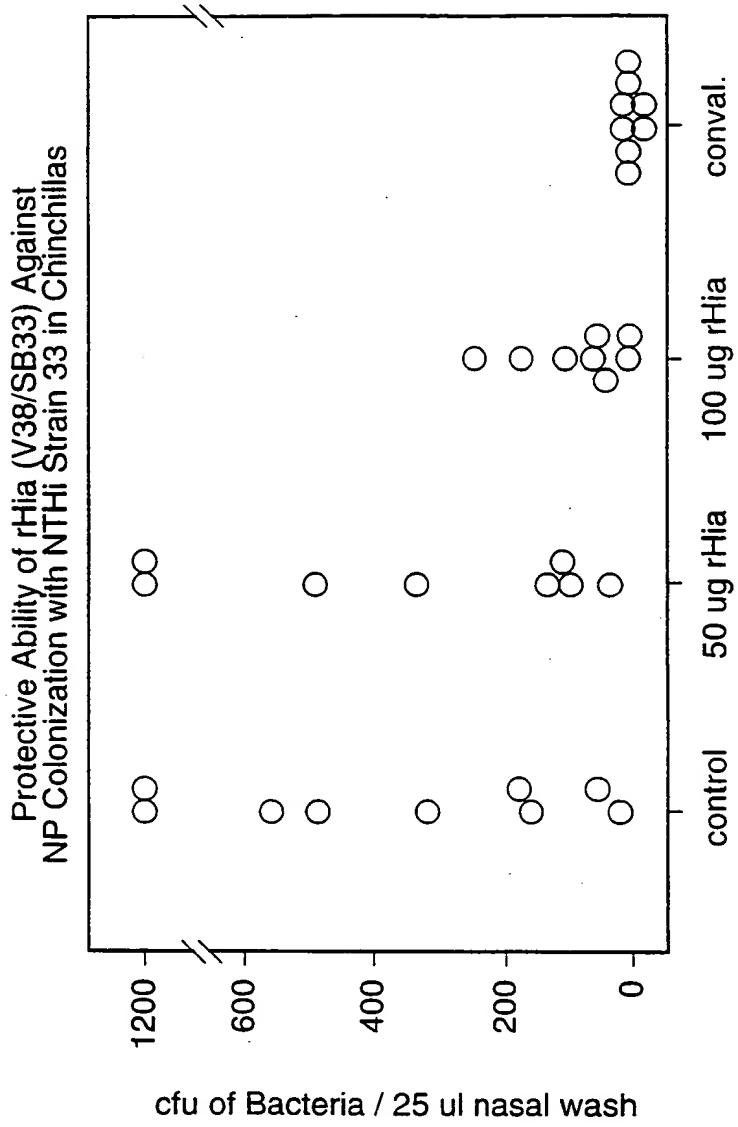


FIG.16

FIG.17

Oligonucleotides used to PCR amplify additional *hia* genes.

sense

SEQ ID NO:22

M N K I F N V

5′ TTAAATATAAGGTAAATAAAAATGAACAAAATTTTTAACGTT 3′ 5040.SL

SEQ ID NO:21

antisense

SEQ ID NO:5

K T G V A A G V G Y Q W * *

5′ AAACAGGCGTTGCAGCAGGTGTTGGTTACCAGTGGTAATAG 3′

SEQ ID NO:4

3′ TTTTGTCCGCAACGTCGTCCACAACCAATGGTCACCATTATCTTAAGGCCTAGGCG 5′ 5039.SL

SEQ ID NO:3

EcoR I BamH I

FIG.18A

NTHi strain 33 Hia

```
                                        MET  ASN  LYS...
G A A T T C G G C T T A A A T A A A A A T G A A C A A ...
              10                  20              ...
                                ...  ILE  PHE  ASN  VAL  ILE  TRP  ASN  VAL  MET  THR  GLN
                                ...A A T T T T T A A C G T T A T T T G G A A T G T T A T G A C T C A
                                ...  30                  40                  50                  60

  THR  TRP  ALA  VAL  VAL  SER  GLU  LEU  THR...
A A C T T G G G C T G T C G T A T C T G A A C T C A C ...
              70                  80              ...
                                ...  ARG  ALA  HIS  THR  LYS  ARG  ALA  SER  ALA  THR  VAL
                                ...T C G C G C C C A C A C C A A A C G T G C C T C C G C A A C C G T
                                ...  90                  100                 110                 120

  ALA  ALA  ALA  VAL  LEU  ALA  THR  VAL  LEU...
G G C A G C C G C T G T A T T G G C G A C C G T A T T ...
              130                 140             ...
                                ...  SER  ALA  THR  VAL  GLN  ALA  SER  ALA  GLY  SER  THR
                                ...G T C T G C A A C G G T T C A G G C G A G T G C A G G C A G T A C
                                ...  150                 160                 170                 180

  THR  GLY  THR  ASN  SER  LEU  ASN  VAL  TYR...
G A C A G G T A C A A A T A G T T T G A A T G T T T A ...
              190                 200             ...
```

FIG.18B

```
...  GLY  LYS  ASN  ASN  SER  ASN  PHE  ASN  SER  ALA  ASN
...T G G A A A G A A T A A T T C G A A T T T C A A T T C A G C C A A
...  210                  220                  230                  240

ASN  SER  ILE  ALA  ASP  LEU  ASN  LYS  GLN...
T A A T T C A A T A G C A G A T T T A A A T A A A C A ...
          250                  260                  ...

...  ASN  ASP  SER  VAL  TYR  ASP  GLY  LEU  LEU  ASN  LEU
...A A A T G A T A G T G T T T A C G A T G G T T T A T T A A A T C T
...  270                  280                  290                  300

ASN  GLU  LYS  GLY  THR  ASP  LYS  SER  LYS...
G A A T G A A A A A G G T A C G G A T A A G T C A A A ...
          310                  320                  ...

...  PHE  LEU  VAL  ALA  ASP  GLU  THR  THR  ALA  THR  VAL
...A T T C C T G G T T G C T G A C G A A A A C C A C C G C A A C C G T
...  330                  340                  350                  360

GLY  ASN  LEU  ARG  LYS  LEU  GLY  TRP  VAL...
A G G C A A T T T A C G T A A A T T G G G T T G G G T ...
          370                  380                  ...

...  VAL  SER  THR  LYS  ASN  SER  THR  LYS  GLU  GLU  SER
...A G T A T C A A C C C A A A A A C A G T A C G A A A G A A G A A A G
...  390                  400                  410                  420
```

FIG.18C

```
   ASN  GLN  VAL  LYS  GLN  ALA  ASP  GLU  VAL...
C A A T C A A G T C A A A C A G G C G G A T G A A G T ...
          430            440            ...
                         ...  LEU  PHE  GLU  GLY  LYS  ASP  GLY  VAL  THR  VAL  THR
                         ...G T T G T T T G A A G G C A A A G A C G G T G T A A C G G T T A C
                         ...  450            460            470            480

   SER  LYS  SER  GLU  ASN  GLY  LYS  HIS  THR...
T T C C A A A T C T G A A A A C G G C A A A C A C A C ...
          490            500            ...
                         ...  VAL  THR  PHE  ALA  LEU  ALA  ASN  ASP  LEU  ASN  VAL
                         ...C G T T A C T T T T G C C C T T G C G A A T G A C C T T A A T G T
                         ...  510            520            530            540

   LYS  ASN  ALA  THR  VAL  SER  ASP  LYS  LEU...
A A A A A A C G C A A C C G T T A G C G A T A A A T T ...
          550            560            ...
                         ...  SER  LEU  GLY  ALA  ASN  GLY  LYS  LYS  VAL  ASP  ILE
                         ...A T C G C T T G G T G C A A A C G G C A A G A A A G T C G A T A T
                         ...  570            580            590            600

   THR  SER  ASP  ALA  ASN  GLY  LEU  LYS  PHE...
T A C C A G T G A T G C A A A C G G C T T G A A A T T ...
          610            620            ...
```

FIG.18D

```
...   ALA  LYS  GLN  GLY  THR  ASN  GLY  GLN  ASN  GLY  ASN
...T G C G A A A C A G G G T A C G A A T G G T C A A A A C G G T A A
...  630                  640                  650                  660

  VAL  HIS  LEU  ASN  GLY  ILE  ALA  SER  THR...
T G T T C A C T T A A A C G G G T A T T G C T T C G A C ...
                670                  680                  ...

...   LEU  ASP  ASP  PRO  ARG  VAL  GLY  GLY  LYS  THR  ALA
...T T T A G A T G A T C C C T C G T G T G G G G A A A A A C A G C
...  690                  700                  710                  720

  HIS  LEU  THR  LYS  GLU  ILE  SER  ASP  THR...
A C A C C T T A C A A A A G A A A T C A G C G A T A C ...
                730                  740                  ...

...   GLU  ARG  ASN  ARG  ALA  ALA  SER  VAL  GLY  ASP  VAL
...A G A A C G T A A C C G T G C T G C G A G C G T G G G C G A T G T
...  750                  760                  770                  780

  LEU  ASN  ALA  GLY  TRP  ASN  ILE  ARG  GLY...
A T T G A A T G C G G G T T G G A A T A T T C G T G G ...
                790                  800                  ...

...   ALA  LYS  THR  ILE  GLY  GLY  THR  VAL  ASP  ASN  VAL
...C G C A A A A A C G A T T G G C G G T A C A G T G G A T A A T G T
...  810                  820                  830                  840
```

FIG.18E

```
ASP PHE VAL SER THR TYR ASP THR VAL...
T G A T T T T G T T T C A A C T T A T G A C A C T G T ...
          850                 860                 ...
... GLU PHE ALA SER GLY ALA ASN ALA ASN VAL SER
...T G A A T T T G C C A G C G G C G C A A A C G C A A A T G T G A G
... 870                 880                 890                 900

VAL THR THR ASP ASP ASN LYS LYS THR...
C G T T A C G A C T G A T G A T A A C A A A A A A A C ...
          910                 920                 ...
... THR VAL ARG VAL ASP VAL THR GLY LEU PRO VAL
...A A C C G T C C G T G T G G A T G T A A C A G G C T T G C C G G T
... 930                 940                 950                 960

GLN TYR VAL THR GLU ASP SER LYS THR...
C C A A T A T G T T A C G G A A G A C A G C A A A A C ...
          970                 980                 ...
... VAL VAL LYS VAL GLY ASN GLU TYR TYR GLU ALA
...C G T T G T G A A A G T G G G C A A T G A G T A T T A C G A A G C
... 990                 1000                1010                1020

LYS GLN ASP GLY SER ALA ASP MET ASP...
C A A G C A A G A C G G T T C G G C G G A T A T G G A ...
          1030                1040                ...
```

FIG.18F

```
...  LYS  LYS  VAL  GLU  ASN  GLY  LYS  LEU  ALA  LYS  THR
...T A A A A A A G T C G A A A T G G C A A G C T G G C G A A A A C
... 1050                1060                1070                1080

  LYS  VAL  LYS  LEU  VAL  SER  ALA  ASN  GLY...
T A A A G T G A A A T T G G T A T C G G C A A A C G G ...
                1090                1100                ...
...  THR  ASN  PRO  VAL  LYS  ILE  SER  ASN  VAL  ALA  ASP
...T A C A A A T C C G G T G A A A A T C A G C A A T G T T G C G G A
... 1110                1120                1130                1140

  GLY  THR  GLU  ASP  THR  ASP  ALA  VAL  SER...
C G G C A C G G A A G A T A C C G A T G C G G T C A G ...
                1150                1160                ...
...  PHE  LYS  GLN  LEU  LYS  ALA  LEU  GLN  ASP  LYS  GLN
...C T T T A A G C A G T T G A A A G C C C T T G C A A G A T A A A C A
... 1170                1180                1190                1200

  VAL  THR  LEU  SER  ALA  SER  ASN  ALA  TYR...
G G T T A C G T T A A G T G C G A G C A A T G C T T A ...
                1210                1220                ...
...  ALA  ASN  GLY  GLY  SER  ASP  ALA  ASP  GLY  GLY  LYS
...T G C C A A T G G C G G T A G C G A T G C C C G A C G G C G G C A A
... 1230                1240                1250                1260
```

FIG.18G

```
   ALA  THR  GLN  THR  LEU  GLY  ASN  ASP  LEU...
GGCAACTCAAACTTTAGGCAATGATTT...
          1270           1280           ...
                                ...  ASN  PHE  LYS  PHE  LYS  SER  THR  ASP  SER  GLU  LEU
                                ...GAATTTTAAATTTAAATCCACAGACAGCGAGTT
                                ... 1290           1300           1310           1320

   LEU  ASN  ILE  LYS  ALA  ALA  GLY  ASP  THR...
GTTGAACATCAAAGCAGCAGGTGACAC...
          1330           1340           ...
                                ...  VAL  THR  PHE  THR  PRO  LYS  LYS  GLY  SER  VAL  GLN
                                ...GGTTACCTTTACGCCGAAAAAAGGTTCGGTGCA
                                ... 1350           1360           1370           1380

   VAL  GLY  ASP  ASP  GLY  LYS  ALA  THR  ILE...
GGTTGGCGATGATGGTAAGGCTACGAT...
          1390           1400           ...
                                ...  GLN  ASP  GLY  ALA  LYS  THR  THR  THR  GLY  LEU  VAL
                                ...TCAAGACGGCGCGAAAACAACTACCGGTTTGGT
                                ... 1410           1420           1430           1440

   GLU  ALA  SER  GLU  LEU  VAL  ASP  SER  LEU...
TGAGGCTTCTGAATTGGTTGACAGCCT...
          1450           1460           ...
```

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FIG.18H

```
                                    ...  ASN  LYS  LEU  GLY  TRP  LYS  VAL  GLY  VAL  GLY  LYS
                                    ...G A A C A A A T T G G G C T G G A A A G T G G G C G T T G G T A A
                                    ... 1470              1480              1490              1500

  ASP  GLY  THR  GLY  ALA  THR  ASP  GLY  THR...
A G A C G G C A C A G G A G C G A C C G A T G G C A C ...
             1510              1520              ...
                                    ...  HIS  THR  ASP  THR  LEU  VAL  LYS  SER  GLY  ASP  LYS
                                    ...G C A T A C C G A C A C T T T A G T G A A G T C G G G C G A T A A
                                    ... 1530              1540              1550              1560

  VAL  THR  LEU  LYS  ALA  GLY  ASP  ASN  LEU...
A G T A A C T T T G A A A G C C G G C G A T A A T C T ...
             1570              1580              ...
                                    ...  LYS  VAL  LYS  GLN  GLU  GLY  THR  ASN  PHE  THR  TYR
                                    ...G A A G G T C A A A C A A G A G G G T A C A A A C T T C A C T T A
                                    ... 1590              1600              1610              1620

  VAL  LEU  ARG  ASP  GLU  LEU  THR  GLY  VAL...
C G T G C T C A G A G A T G A A T T G A C G G G C G T ...
             1630              1640              ...
                                    ...  LYS  SER  VAL  GLU  PHE  LYS  ASP  THR  GLU  ASN  GLY
                                    ...A A A G A G C G T G G A G T T T A A A G A C A C G G A G A A T G G
                                    ... 1650              1660              1670              1680
```

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FIG.18I

```
   ALA  ASN  GLY  ALA  SER  THR  LYS  ILE  THR...
T G C A A A C G G T G C A A G C A C G A A G A T T A C ...
            1690              1700              ...
                                ...  LYS  ASP  GLY  LEU  THR  ILE  THR  PRO  ALA  ASN  ASP
                                ...C A A A G A C G G C T T G A C C A T T A C G C C G G C A A A C G A
                                ... 1710              1720              1730              1740

   ALA  ASN  GLY  ALA  ALA  ALA  THR  ASP  ALA...
T G C G A A T G G T G C G G C G G C G A C T G A T G C ...
            1750              1760              ...
                                ...  ASP  LYS  ILE  LYS  VAL  ALA  SER  ASP  GLY  ILE  SER
                                ...T G A C A A G A T T A A A G T G G C T T C A G A C G G C A T T A G
                                ... 1770              1780              1790              1800

   ALA  GLY  ASN  LYS  ALA  VAL  LYS  ASN  VAL...
T G C G G G T A A T A A A G C A G T T A A A A A C G T ...
            1810              1820              ...
                                ...  VAL  SER  GLY  LEU  LYS  LYS  PHE  GLY  ASP  ALA  ASN
                                ...T G T G A G C G G A C T G A A G A A A T T T G G T G A T G C G A A
                                ... 1830              1840              1850              1860

   PHE  ASN  PRO  LEU  THR  SER  SER  ALA  ASP...
T T T C A A T C C G C T G A C T A G C T C A G C C G A ...
            1870              1880              ...
```

FIG.18J

```
                                    ...  ASN  LEU  THR  LYS  GLN  TYR  ASP  ASN  ALA  TYR  LYS
                                    ...C A A C T T A A C G A A A C A A T A T G A C A A T G C C T A T A A
                                    ... 1890              1900              1910              1920

  GLY  LEU  THR  ASN  LEU  ASP  GLU  LYS  SER...
A G G C T T G A C C A A T C T G G A T G A A A A A A G ...
            1930              1940              ...
                                    ...  LYS  GLY  LYS  GLN  THR  PRO  THR  VAL  ALA  ASP  ASN
                                    ...T A A A G G C A A G C A A A C T C C G A C C G T T G C T G A C A A
                                    ... 1950              1960              1970              1980

  THR  ALA  ALA  THR  VAL  GLY  ASP  LEU  ARG...
T A C C G C T G C A A C C G T G G G C G A T T T G C G ...
            1990              2000              ...
                                    ...  GLY  LEU  GLY  TRP  VAL  ILE  SER  ALA  ASP  LYS  THR
                                    ...C G G T T T G G G C T G G G T C A T T T C T G C A G A C A A A A C
                                    ... 2010              2020              2030              2040

  THR  GLY  GLU  SER  LYS  GLU  TYR  SER  ALA...
C A C A G G C G A G T C A A A G G A A T A T A G C G C ...
            2050              2060              ...
                                    ...  GLN  VAL  ARG  ASN  ALA  ASN  GLU  VAL  LYS  PHE  LYS
                                    ...G C A A G T G C G T A A C G C C A A T G A A G T G A A A T T C A A
                                    ... 2070              2080              2090              2100
```

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FIG.18K

```
   SER  GLY  ASN  GLY  ILE  ASN  VAL  SER  GLY...
G A G C G G G C A A C G G T A T C A A T G T T C C G G ...
                2110                              ...
                                                  LYS  THR  LEU  ASP  ASN  GLY  THR  ARG  GLU  ILE  THR
                                                ...T A A A A C A T T G G A T A A C G G T A C G C G C G A A A T T A C
                                                ... 2130                    2140                    2150                    2160

   PHE  GLU  LEU  ALA  LYS  ASP  GLU  ASN  ALA...
T T T G A A T T G G C T A A A G A C G A A A A T G C ...
                2170                    2180                    ...
                                          ILE  ALA  PHE  GLY  SER  GLY  SER  LYS  ALA  LEU  ARG
                                        ...C A T T G C T T T C G G T T C T G G C T C A A A A G C C T T G C G
                                        ... 2190                    2200                    2210                    2220

   ASP  ASN  THR  VAL  ALA  LYS  ILE  GLY  THR  GLY...
C G A T A A C A C G G T G G C G A T T G G T A C G G G ...
                2230                    2240                    ...
                                          ASN  VAL  VAL  ASN  ALA  GLU  LYS  SER  GLY  ALA  PHE
                                        ...C A A C G T T G T G A A T G C G G A A A A A T C T G G T G C A T T
                                        ... 2250                    2260                    2270                    2280

   GLY  ASP  PRO  ASN  TYR  ILE  GLU  ASP  LYS...
C G G C G A T C C G A A C T A C A T C G A A G A T A A ...
                2290                    2300                    ...
```

FIG.18L

```
                                    ...  ALA  GLY  GLY  SER  TYR  ALA  PHE  GLY  ASN  ASP  ASN
                                    ...A G C C G G T G G C A G C T A C G C T T T C G G T A A C G A T A A
                                    ... 2310              2320              2330              2340

  ARG  ILE  THR  SER  LYS  ASN  THR  PHE  VAL...
C C G T A T T A C T T C T A A A A A C A C T T T T G T ...
           2350              2360              ...
                                    ...  LEU  GLY  ASN  GLY  VAL  ASN  ALA  LYS  TYR  LYS  ALA
                                    ...G T T G G G T A A T G G A G T T A A T G C G A A A T A T A A A G C
                                    ... 2370              2380              2390              2400

  ASN  GLY  ASP  VAL  ASP  THR  GLU  THR  VAL...
C A A T G G A G A T G T T G A T A C G G A A A C C G T ...
           2410              2420              ...
                                    ...  THR  VAL  LYS  ASP  LYS  ASP  GLY  LYS  GLU  THR  THR
                                    ...A A C T G T T A A G G A C A A A G A C G G T A A A G A G A C T A C
                                    ... 2430              2440              2450              2460

  VAL  THR  VAL  PRO  LYS  ALA  LEU  GLY  ALA...
C G T T A C T G T T C C T A A A G C G T T A G G G G C ...
           2470              2480              ...
                                    ...  THR  VAL  GLU  ASN  SER  VAL  TYR  LEU  GLY  ASN  LYS
                                    ...T A C G G T T G A A A A C T C C G T T T A T T T G G G T A A T A A
                                    ... 2490              2500              2510              2520
```

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FIG.18M

```
   SER  THR  ALA  THR  LYS  ASP  LYS  GLY  LYS...
A T C G A C T G C G A C A A A A G A T A A G G G T A A ...
      2530                2540                ...

...  ASN  LEU  LYS  SER  ASP  GLY  THR  ALA  GLY  ASN  THR
...A A A T C T G A A A T C T G A T G G T A C G G C G G G T A A C A C
... 2550                2560                2570                2580

   THR  THR  ALA  GLY  THR  THR  GLY  THR  VAL...
T A C A A C T G C T G G T A C A A C G G G T A C G G T ...
      2590                2600                ...

...  ASN  GLY  PHE  ALA  GLY  ALA  THR  ALA  HIS  GLY  ALA
...A A A C G G C T T T G C C G G T G C C A A C G G G C G C A C G G T G C
... 2610                2620                2630                2640

   VAL  SER  VAL  GLY  ALA  SER  GLY  GLU  GLU...
G G T T T C T G T C G G C G C A A G C G G C G A A G A ...
      2650                2660                ...

...  ARG  ARG  ILE  GLN  ASN  VAL  ALA  ALA  GLY  GLU  ILE
...A A G A C G T A T C C A A A A C G T T G C G G G C A G G C G A A A T
... 2670                2680                2690                2700

   SER  ALA  THR  SER  THR  ASP  ALA  ILE  ASN...
T T C C G C T A C T T C C A C C G A T G C G A T T A A ...
      2710                2720                ...
```

FIG.18N

```
                                    ...  GLY  SER  GLN  LEU  TYR  ALA  VAL  ALA  LYS  GLY  VAL
                                    ...C G G C A G C C A G T T G T A T G C C G T G G C A A A A G G G G T
                                    ... 2730              2740              2750              2760

  THR  ASN  LEU  ALA  GLY  GLN  VAL  ASN  LYS...
A A C A A A C C T T G C T G G A C A A G T G A A T A A ...
            2770              2780              ...
                                    ...  VAL  GLY  LYS  ARG  ALA  ASP  ALA  GLY  THR  ALA  SER
                                    ...A G T G G G C A A A C G T G C A G A T G C A G G T A C A G C A A G
                                    ... 2790              2800              2810              2820

  ALA  LEU  ALA  ALA  SER  GLN  LEU  PRO  GLN...
T G C A T T A G C G G C T T C A C A G T T A C C A C A ...
            2830              2840              ...
                                    ...  ALA  SER  MET  SER  GLY  LYS  SER  MET  VAL  SER  ILE
                                    ...A G C C T C T A T G T C A G G T A A A T C A A T G G T T T C T A T
                                    ... 2850              2860              2870              2880

  ALA  GLY  SER  SER  TYR  GLN  GLY  GLN  SER...
T G C G G G A A G T A G T T A T C A A G G T C A A A G ...
            2890              2900              ...
                                    ...  GLY  LEU  ALA  ILE  GLY  VAL  SER  ARG  ILE  SER  ASP
                                    ...T G G T T T A G C T A T C G G G G T A T C A A G A A T T T C C G A
                                    ... 2910              2920              2930              2940
```

FIG.18O

```
  ASN  GLY  LYS  VAL  ILE  ILE  ARG  LEU  SER...
T A A T G G C A A A G T G A T T A T T C G C T T G T C ...
                2950                    2960                ...
                               ...  GLY  THR  THR  ASN  SER  GLN  GLY  LYS  THR  GLY  VAL
                               ...A G G C A C A A C C A A T A G C C A A G G T A A A A C A G G C G T
                               ... 2970                2980                2990                3000

  ALA  ALA  GLY  VAL  GLY  TYR  GLN  TRP  ***
T G C A G C A G G T G T T G G T T A C C A G T G G T A ...
                3010                    3020                ...

                               ...A T A G A A T T C
                               ... 3030
```

FIG.19A

NTHi strain 32 *hia*

```
G A A T T C G G C T T T A A A T A T A A G G T A A A T A A A ...
              10                  20                  30 ...
                                    MET   ASN   LYS   ILE   PHE   ASN   VAL   ILE   TRP   ASN
                                ...A A T G A A C A A A A T T T T T A A C G T T A T T T G G A A
                                ...                 40                  50                  60

   VAL   VAL   THR   GLN   THR   TRP   VAL   VAL   VAL   SER...
T G T T G T G A C T C A A A C T T G G G T T G T C G T A T C ...
              70                  80                  90 ...
                                ...   GLU   LEU   THR   ARG   THR   HIS   THR   LYS   CYS   ALA
                                ...T G A A C T C A C T C G C A C C C A C A C C A A A T G C G C
                                ...                 100                 110                 120

   SER   ALA   THR   VAL   ALA   VAL   ALA   VAL   LEU   ALA...
C T C C G C C A C C G T G G C A G T T G C C G T A T T G G C ...
              130                 140                 150 ...
                                ...   THR   LEU   LEU   SER   ALA   THR   VAL   GLN   ALA   ASN
                                ...A A C C C T G T T G T C C G C A A C G G T T C A G G C G A A
                                ...                 160                 170                 180

   ALA   THR   ASP   GLU   ASN   GLU   ASP   ASP   GLU   GLU...
T G C T A C C G A T G A A A A C G A A G A T G A T G A A G A ...
              190                 200                 210 ...
```

FIG.19B

```
...  GLU  LEU  GLU  PRO  VAL  GLN  ARG  SER  VAL  LEU
...A G A G T T A G A A C C C G T A C A A C G C T C T G T T T T
...                 220                 230                 240

  ARG  TRP  SER  PHE  LYS  SER  ALA  LYS  GLU  GLY...
A A G G T G G A G C T T C A A A T C C G C T A A G G A A G G ...
          250                 260                 270 ...

...  THR  GLY  GLU  GLN  GLU  GLY  THR  THR  GLU  VAL
...C A C T G G A G A A C A A G A G G G A A C A A C A G A G G T
...                 280                 290                 300

  ILE  ASN  LEU  ASN  THR  ASP  SER  SER  GLY  ASN...
A A T A A A T T T G A A C A C A G A T T C A T C A G G A A A ...
          310                 320                 330 ...

...  ALA  VAL  GLY  SER  SER  THR  ILE  THR  PHE  LYS
...T G C A G T A G G G A A G C A G C A C A A T C A C C T T C A A
...                 340                 350                 360

  ALA  GLY  ASP  ASN  LEU  LYS  ILE  LYS  GLN  SER...
A G C C G G C G A C A A C C T G A A A A A T C A A A A C A A A G ...
          370                 380                 390 ...

...  GLY  ASN  ASP  PHE  THR  TYR  SER  LEU  LYS  LYS
...C G G C A A T G A C T T C A C C T A C T C G C T G A A A A A
...                 400                 410                 420
```

FIG.19C

```
   GLU  LEU  LYS  ASN  LEU  THR  SER  VAL  GLU  THR...
A G A G C T G A A A A A C C T G A C C A G T G T T G A A A C ...
                430                 440                 450 ...
...                 GLU  LYS  LEU  SER  PHE  GLY  ALA  ASN  GLY  ASN
...T G A A A A A T T A T C G T T T G G C G C A A A C G G C A A
...                 460                 470                 480

   LYS  VAL  ASP  ILE  THR  SER  ASP  ALA  ASN  GLY...
T A A A G T T G A T A T T A C C A G T G A T G C A A A T G G ...
                490                 500                 510 ...
...   LEU  LYS  LEU  ALA  LYS  THR  GLY  ASN  GLY  ASN
...C T T G A A A T T G G C G A A A A C A G G T A A C G G A A A
...                 520                 530                 540

   GLY  GLN  ASN  SER  ASN  VAL  HIS  LEU  ASN  GLY...
T G G T C A A A A A C A G T A A T G T T C A C T T A A A C G G ...
                550                 560                 570 ...
...   ILE  ALA  SER  THR  LEU  THR  ASP  THR  LEU  ALA
...T A T T G C T T C G A C T T T G A C C G A T A C G C T T G C
...                 580                 590                 600

   GLY  GLY  THR  THR  GLY  HIS  VAL  ASP  THR  ASN...
C G G T G G C A C A A C A G G A C A C G T T G A C A C C A A ...
                610                 620                 630 ...
```

FIG.19D

```
...     ILE   ASP   ALA   VAL   ASN   TYR   HIS   ARG   ALA   ALA
...C A T T G A T G C G G T T A A T T A T C A T C G C G C T G C
...                640                 650                 660

  SER   VAL   GLN   ASP   VAL   LEU   ASN   SER   GLY   TRP...
A A G C G T A C A A G A T G T G T T A A A C A G C G G T T G ...
                670                 680                 690 ...
...     ASN   ILE   GLN   GLY   ASN   GLY   ASN   ASN   VAL   ASP
...G A A T A T C C A A G G C A A T G G A A A C A A T G T C G A
...                700                 710                 720

  PHE   VAL   ARG   THR   TYR   ASP   THR   VAL   ASP   PHE...
T T T T G T C C G T A C T T A C G A C A C C G T G G A C T T ...
                730                 740                 750 ...
...     VAL   ASN   GLY   ALA   ASN   ALA   ASN   VAL   SER   VAL
...T G T C A A T G G C G C G A A T G C C A A T G T G A G C G T
...                760                 770                 780

  THR   ALA   ASP   THR   ALA   HIS   LYS   LYS   THR   THR...
T A C G G C T G A T A C G G C T C A C A A A A A G A C A A C ...
                790                 800                 810 ...
...     VAL   ARG   VAL   ASP   VAL   THR   GLY   LEU   PRO   VAL
...T G T C C G T G T G G A T G T A A C A G G C T T G C C G G T
...                820                 830                 840
```

FIG.19E

```
   GLN   TYR   VAL   THR   GLU   ASP   GLY   LYS   THR   VAL...
T C A A T A T G T T A C G G A A G A C G G C A A A A C C G T ...
               850                 860                 870 ...
                                  ...   VAL   LYS   VAL   GLY   ASN   GLU   TYR   TYR   LYS   ALA
                                  ...T G T G A A A G T G G G C A A T G A G T A T T A C A A A G C
                                  ...                 880                 890                 900

   LYS   ASP   ASP   GLY   SER   ALA   ASP   MET   ASN   GLN...
C A A A G A T G A C G G T T C G G C G G A T A T G A A T C A ...
               910                 920                 930 ...
                                  ...   LYS   VAL   GLU   ASN   GLY   GLU   LEU   ALA   LYS   THR
                                  ...A A A A G T C G A A A A C G G C G A G C T G G C G A A A A C
                                  ...                 940                 950                 960

   LYS   VAL   LYS   LEU   VAL   SER   ALA   SER   GLY   THR...
C A A A G T G A A A T T G G T A T C G G C A A G C G G T A C ...
               970                 980                 990 ...
                                  ...   ASN   PRO   VAL   LYS   ILE   SER   ASN   VAL   ALA   ASP
                                  ...A A A T C C G G T G A A A A T T A G C A A T G T T G C A G A
                                  ...                 1000                1010                1020

   GLY   THR   GLU   ASP   THR   ASP   ALA   VAL   SER   PHE...
C G G C A C G G A A G A C A C C G A T G C G G T C A G C T T ...
               1030                1040                1050 ...
```


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FIG.19F

```
                                        ...  LYS  GLN  LEU  LYS  ALA  LEU  GLN  ASP  LYS  GLN
                                        ...T A A G C A A T T A A A A G C C T T G C A A G A C A A A C A
                                        ...            1060            1070            1080

  VAL  THR  LEU  SER  THR  SER  ASN  ALA  TYR  ALA...
G G T T A C G T T G A G C A C G A G C A A T G C T T A T G C ...
          1090            1100            1110 ...
                                        ...  ASN  GLY  GLY  THR  ASP  ASN  ASP  GLY  GLY  LYS
                                        ...C A A T G G C G G T A C A G A T A A C G A C G G C G G C A A
                                        ...            1120            1130            1140

  ALA  THR  GLN  THR  LEU  SER  ASN  GLY  LEU  ASN...
G G C A A C T C A A A C T T T A A G C A A T G G T T T G A A ...
          1150            1160            1170 ...
                                        ...  PHE  LYS  PHE  LYS  SER  SER  ASP  GLY  GLU  LEU
                                        ...T T T T A A A T T T A A A T C T A G C G A T G G C G A G T T
                                        ...            1180            1190            1200

  LEU  LYS  ILE  SER  ALA  THR  GLY  ASP  THR  VAL...
G T T G A A A A T T A G C G C G A C C G G C G A T A C G G T ...
          1210            1220            1230 ...
                                        ...  THR  PHE  THR  PRO  LYS  LYS  GLY  SER  VAL  GLN
                                        ...T A C T T T T A C G C C G A A A A A A G G T T C G G T A C A
                                        ...            1240            1250            1260
```


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FIG.19G

```
  VAL  GLY  ASP  ASP  GLY  LYS  ALA  SER  ILE  SER...
G G T T G G C G A T G A T G G C A A G G C T T C A A T T T C ...
      1270                1280                1290 ...

...  LYS  GLY  ALA  ASN  THR  THR  GLU  GLY  LEU  VAL
...A A A A G G T G C A A A T A C A A C T G A A G G T T T G G T
...          1300                1310                1320
...

  GLU  ALA  SER  GLU  LEU  VAL  GLU  SER  LEU  ASN...
T G A G G C T T C T C T G A A T T G G T T G A A A G C C T G A A ...
      1330                1340                1350 ...

...  LYS  LEU  GLY  TRP  LYS  VAL  GLY  VAL  GLU  LYS
...C A A A C T G G G T T G G A A A G T A G G G G T T G A G A A
...          1360                1370                1380
...

  VAL  GLY  SER  GLY  GLU  LEU  ASP  GLY  THR  SER...
A G T C G G G C A G C C G G C G A G C T T G A T G G T A C A T C ...
      1390                1400                1410 ...

...  LYS  GLU  THR  LEU  VAL  LYS  SER  GLY  ASP  LYS
...C A A G G G A A A C T T T A G T G A A G T C G G G C G A T A A
...          1420                1430                1440
...

  VAL  THR  LEU  LYS  ALA  GLY  ASP  ASN  LEU  LYS...
A G T A A C T T T G A A A G C C G G C G A C A A T C T G A A ...
      1450                1460                1470 ...
```

FIG.19H

```
                                ... VAL  LYS  GLN  GLU  GLY  THR  ASN  PHE  THR  TYR
                                ...G G T C A A A C A A G A G G G C A C A A A C T T C A C T T A
                                ...            1480                1490                1500

ALA  LEU  LYS  ASP  GLU  LEU  THR  GLY  VAL  LYS...
C G C G C T C A A A G A T G A A T T G A C G G G C G T G A A ...
           1510                1520                1530 ...
                                ... SER  VAL  GLU  PHE  LYS  ASP  THR  ALA  ASN  GLY
                                ...G A G C G T G G A G T T T A A A G A C A C G G C G A A T G G
                                ...            1540                1550                1560

ALA  ASN  GLY  ALA  SER  THR  LYS  ILE  THR  LYS...
T G C A A A C G G T G C A A G C A C G A A G A T T A C C A A ...
           1570                1580                1590 ...
                                ... ASP  GLY  LEU  THR  ILE  THR  LEU  ALA  ASN  GLY
                                ...A G A C G G C T T G A C C A T T A C G C T G G C A A A C G G
                                ...            1600                1610                1620

ALA  ASN  GLY  ALA  THR  VAL  THR  ASP  ALA  ASP...
T G C G A A T G G T G C G A C G G T G A C T G A T G C C G A ...
           1630                1640                1650 ...
                                ... LYS  ILE  LYS  VAL  ALA  SER  ASP  GLY  ILE  SER
                                ...C A A G A T T A A A G T T G C T T C G G A C G G C A T T A G
                                ...            1660                1670                1680
```

FIG.19I

```
ALA  GLY  ASN  LYS  ALA  VAL  LYS  ASN  VAL  ALA...
C G C G G G T A A T A A A G C A G T T A A A A A C G T C G C ...
             1690                     1700                     1710 ...
                                   ...  ALA  GLY  GLU  ILE  SER  ALA  THR  SER  THR  ASP
                                   ...G G C A G G C G A A A T T T C T G C C A C T T C C A C C G A
                                   ...             1720                     1730                     1740

ALA  ILE  ASN  GLY  SER  GLN  LEU  TYR  ALA  VAL...
T G C G A T T A A C G G A A G C C A G T T G T A T G C C G T ...
             1750                     1760                     1770 ...
                                   ...  ALA  LYS  GLY  VAL  THR  ASN  LEU  ALA  GLY  GLN
                                   ...G G C A A A A G G G G T A A C A A A C C T T G C T G G A C A
                                   ...             1780                     1790                     1800

VAL  ASN  ASN  LEU  GLU  GLY  LYS  VAL  ASN  LYS...
A G T G A A T A A T C T T G A G G G C A A A G T G A A T A A ...
             1810                     1820                     1830 ...
                                   ...  VAL  GLY  LYS  ARG  ALA  ASP  ALA  GLY  THR  ALA
                                   ...A G T G G G C A A A C G T G C A G A T G C A G G T A C T G C
                                   ...             1840                     1850                     1860

SER  ALA  LEU  ALA  ALA  SER  GLN  LEU  PRO  GLN...
A A G T G C A T T A G C G G C T T C A C A G T T A C C A C A ...
             1870                     1880                     1890 ...
```

FIG.19J

```
                              ...  ALA  THR  MET  PRO  GLY  LYS  SER  MET  VAL  SER
                              ...A G C C A C T A T G C C A G G T A A A T C A A T G G T T T C
                              ...            1900                1910                1920

 ILE  ALA  GLY  SER  SER  TYR  GLN  GLY  GLN  ASN...
T A T T G C G G G A A G T A G T T A T C A A G G T C A A A A ...
           1930                1940                1950 ...
                              ...  GLY  LEU  ALA  ILE  GLY  VAL  SER  ARG  ILE  SER
                              ...T G G T T T A G C T A T C G G G G T A T C A A G A A T T T C
                              ...            1960                1970                1980

 ASP  ASN  GLY  LYS  VAL  ILE  ILE  ARG  LEU  SER...
C G A T A A T G G C A A A G T G A T T A T T C G C T T G T C ...
           1990                2000                2010 ...
                              ...  GLY  THR  THR  ASN  SER  GLN  GLY  LYS  THR  GLY
                              ...A G G C A C A A C C A A T A G T C A A G G T A A A A C A G G
                              ...            2020                2030                2040

 VAL  ALA  ALA  GLY  VAL  GLY  TYR  GLN  TRP  ***
C G T T G C A G C A G G T G T T G G T T A C C A G T G G T A ...

                              ...A T A G A A T T C
```

FIG.20A

NTHi strain 29 Hia

```
                                MET  ASN  LYS ...
T T A A A T A T A A G G T A A A T A A A A A T G A A C A A A A...
          10                  20                  30...

... ILE  PHE  ASN  VAL  ILE  TRP  ASN  VAL  VAL  THR
... A T T T T A A C G T T A T T T G G A A T G T T G T G A C T
...                 40                  50                  60

GLN  THR  TRP  VAL  VAL  VAL  SER  GLU  LEU  THR ...
C A A A C T T G G G T T G T C G T A T C T G A A C T C A C T...
          70                  80                  90...

... ARG  ALA  HIS  THR  LYS  CYS  ALA  SER  ALA  THR
... C G C G C C C A C A C C A A A T G C G C C T C C G C C A C C
...                 100                 110                 120

VAL  ALA  VAL  ALA  VAL  LEU  ALA  THR  ALA  LEU ...
G T G G C G G T T G C C G T A T T G G C A A C T G C G T T G...
          130                 140                 150...

... SER  ALA  THR  ALA  GLU  ALA  ASN  ASN  ASN  THR
... T C T G C A A C G G C T G A A G C G A A C A A C A A T A C T
...                 160                 170                 180

SER  VAL  THR  ASN  GLY  LEU  ASN  ALA  TYR  GLY ...
T C T G T T A C G A A T G G G T T G A A T G C T T A T G G C...
                    190                 200                 210...
```

FIG.20B

```
... ASP THR ASN PHE ASN THR THR ASN ASN SER
... G A T A C T A A T T T T A A T A C A A C C A A T A A T T C G
                220       230       240
...

ILE ALA ASP LEU GLU LYS HIS VAL GLN ASP ...
A T A G C A G A T T G G A A A A C A C G T T C A A G A T...
        250       260       270...

... ALA TYR LYS GLY LEU LEU ASN LEU ASN GLU
... G C T T A T A A A G G C T T A T T A A T C T G A A T G A A
                280       290       300
...

LYS ASP THR ASN LYS SER SER PHE LEU VAL ...
A A A G A T A C A A A A T A A G T C A A G T T T C T T G G T T...
        310       320       330...

... ALA ASP ASN THR ALA ALA THR VAL GLY ASN
... G C C G A C A A T A C C G C C G C A A C C G T A G G C A A T
                340       350       360
...

LEU ARG LYS LEU GLY TRP VAL LEU SER SER ...
T T G C G T A A A T T G G G C T G G G T A T T G T C T A G C...
        370       380       390...

... LYS ASN GLY THR ARG ASN GLU LYS SER TYR
... A A A A A C G G C A C A A G G A A C G A G A A A A G C T A T
                400       410       420
...
```

FIG.20C

```
 GLN  VAL  LYS  GLN  ALA  ASP  GLU  VAL  LEU  PHE ...
C A A G T A A A A C A A G C T G A T G A A G T T C T C T T T...
          430                 440                 450...
...   THR  GLY  SER  GLY  ALA  ALA  THR  VAL  SER  SER
... A C T G G A T C T G G T G C T G C A A C G G T T A G T T C C
...                 460                 470                 480
...

 SER  SER  LYS  ASP  GLY  LYS  HIS  THR  ILE  THR ...
A G C T C T A A A G A C G G T A A A A C A T A C C A T T A C C...
          490                 500                 510...
...   ILE  SER  VAL  THR  LYS  GLY  SER  PHE  ALA  GLU
... A T T T C T G T T A C C A A A G G T A G T T T T G C T G A G
...                 520                 530                 540
...

 VAL  LYS  THR  ASP  ALA  THR  THR  GLY  GLY  GLN ...
G T A A A A A C T G A T G C A A C T A C T G G A G G T C A A...
          550                 560                 570...
...   VAL  ASN  ALA  ASP  ARG  GLY  LYS  VAL  LYS  ALA
... G T A A A C G G C C G A C C G T G G T A A A G T G A A A G C T
...                 580                 590                 600
...

 GLU  ASP  GLU  ASN  GLY  ALA  ASP  VAL  ASP  LYS ...
G A G G A C G A G A A T G G A G C T G A T G T T G A T A A G...
          610                 620                 630...
```

FIG.20D

```
                              ... LYS VAL ALA THR VAL LYS ASP VAL ALA LYS
                              ... A A A G T T G C A A C T G T A A A A G A T G T T G C T A A G
                              ...            640             650             660

ALA ILE ASN ASP ALA ALA THR PHE VAL LYS ...
G C G A T T A A C G A T G C C G C A A C T T T C G T G A A A...
           670            680            690...
                              ... VAL GLU SER THR ASP ASP ASP ILE GLU ASN
                              ... G T G G A A A G C A C A G A T G A T G A C A T T G A A A A T
                              ...            700             710             720

GLY ALA ALA GLY LYS ASN GLU THR THR ASP ...
G G T G C T G C A G G C A A A A A T G A A A C T A C A G A C...
           730            740            750...
                              ... GLN ALA LEU LYS ALA GLY ASP THR LEU THR
                              ... C A A G C T C T C A A A G C A G G C G A C A C C T T A A C C
                              ...            760             770             780

LEU LYS ALA GLY LYS ASN LEU LYS ALA LYS ...
T T A A A A G C G G G T A A A A A C T T A A A A G C T A A G...
           790            800            810...
                              ... LEU ASP GLN ASN GLY LYS SER VAL THR PHE
                              ... T T A G A C C A A A A T G G T A A A T C A G T A A C C T T T
                              ...            820             830             840
```

FIG.20E

```
 ALA  LEU  ALA  LYS  ASP  LEU  ASP  VAL  THR  SER ...
G C T T T A G C G A A A G A C C T T G A T G T G A C C T C T...
                  850                 860                 870...
                       ...  ALA  LYS  VAL  SER  ASP  LYS  LEU  SER  ILE  GLY
                       ... G C G A A A G T G A G T G A T A A G T T G T C T A T T G G T
                       ...                 880                 890                 900

 LYS  ASP  THR  ASN  LYS  VAL  ASP  ILE  THR  SER ...
A A A G A T A C G A A A T A A A G T T G A T T A T T A C C A G T...
                  910                 920                 930...
                       ...  ASP  ALA  ASN  GLY  LEU  LYS  LEU  ALA  LYS  THR
                       ... G A T G C A A A T G G C T T G A A A T T G G C G A A A A C A
                       ...                 940                 950                 960

 GLY  ASN  GLY  ASN  GLY  GLN  ASN  GLY  ASN  VAL ...
G G T A A C G G G A A A T G G T C A A A A C G G T A A T G T C...
                  970                 980                 990...
                       ...  HIS  LEU  ASN  GLY  ILE  ALA  SER  THR  LEU  THR
                       ... C A C T T A A A T G G T A T T G C T T C G A C T T T G A C C
                       ...                 1000                1010                1020

 ASP  THR  ILE  THR  GLY  MET  THR  THR  GLN  ALA ...
G A T A C C A T T A C A G G T A T G A C A A C A C A A G C A...
                  1030                1040                1050...
```

FIG.20F

```
... SER ASN GLY VAL ALA VAL GLN ASN HIS ASN
... A G C A A T G G C G T G G C T G T G C A G A A T C A T A A T
...            1060                1070                1080

ARG ALA ALA SER VAL ALA ASP VAL LEU ASN ...
C G T G C T G C G A G T G T G G C T G A T G T A T T A A A T...
         1090                1100                1110...
... ALA GLY TRP ASN ILE GLN GLY ASN GLY ALA
... G C A G G C T G G A A T A T T C A A G G C A A C G G A G C G
...            1120                1130                1140

SER VAL ASP PHE VAL ASN ALA TYR ASP THR ...
A G C G T T G A T T T T G T C A A T G C T T A C G A C A C A...
         1150                1160                1170...
... VAL ASP PHE VAL ASN GLY THR ASN THR ASN
... G T A G A T T T T G T C A A T G G T A C A A A C A C C A A T
...            1180                1190                1200

VAL ASN VAL THR THR ASP THR ALA HIS LYS ...
G T G A A C G T T A C G A C T G A T A C G G C T C A C A A A...
         1210                1220                1230...
... LYS THR THR VAL ARG VAL ASP VAL THR GLY
... A A G A C A A C C G T C C G T G T G G A T G T A A C A G G C
...            1240                1250                1260
```

FIG.20G

```
 LEU  PRO  VAL  GLN  TYR  VAL  THR  GLU  ASP  GLY ...
T T G C C G G T T C A A T A T G T T A C G G A A G A C G G C...
                1270                1280                1290...

                     ... LYS  THR  VAL  VAL  LYS  VAL  ASP  ASN  LYS  TYR
                     ... A A A A C C G T T G T G A A A G T G G A C A A T A A G T A T
                     ...                 1300                1310                1320

 TYR  GLU  ALA  LYS  GLN  ASP  GLY  SER  ALA  ASP ...
T A C G A A G C T A A G C A A G A C G G G T T C G G C G G A T...
                1330                1340                1350...

                     ... MET  ASP  LYS  LYS  VAL  GLU  ASN  GLY  GLU  LEU
                     ... A T G G A T A A A A A A G T C G A A A A A T G G C G A G C T G
                     ...                 1360                1370                1380

 ALA  LYS  THR  LYS  VAL  LYS  LEU  VAL  SER  ALA ...
G C G A A A A C C A A A G T G A A A T T G G T C G G C A...
                1390                1400                1410...

                     ... SER  GLY  GLN  ASN  PRO  VAL  LYS  ILE  SER  ASN
                     ... A G C G G G T C A A A A A T C C G G T G A A A A A T C A G C A A T
                     ...                 1420                1430                1440

 VAL  ALA  GLU  GLY  THR  GLU  GLU  ASN  ASP  ALA ...
G T T G C G G A A G G C A C G G A A G A A A A C G A T G C G...
                1450                1460                1470...
```

FIG.20H

```
                                 ... VAL SER PHE LYS GLN LEU LYS ALA LEU GLN
                                 ... G T C A G C T T T A A G C A A T T G A A A G C C T T G C A A
                                 ...          1480           1490           1500

GLU LYS GLN VAL THR LEU THR ALA SER ASN ...
G A G A A A C A G G T T A C T T T A A C T G C G A G C A A T...
        1510           1520           1530...
                                 ... ALA TYR ALA ASN GLY GLY ASN ASP ALA ASP
                                 ... G C T T A T G C C A A T G G T G G T A A C G A T G C C G A C
                                 ...          1540           1550           1560

GLY GLY LYS ALA THR GLN THR LEU ASN ASN ...
G G C G G C A A G G C A A C T C A A A C T T T A A A C A A T...
        1570           1580           1590...
                                 ... GLY LEU ASN PHE LYS PHE LYS SER THR ASP
                                 ... G G T T T G A A T T T T A A A T T T A A A T C C A C A G A C
                                 ...          1600           1610           1620

GLY GLU LEU LEU ASN ILE LYS VAL GLU ASN ...
G G C G A G T T G T T G A A C A T C A A A G T A G A A A A T...
        1630           1640           1650...
                                 ... ASP THR VAL THR PHE THR PRO LYS LYS GLY
                                 ... G A C A C A G T T A C C T T T A C G C C G A A A A A A G G T
                                 ...          1660           1670           1680
```

FIG.20I

```
SER  VAL  GLN  VAL  GLY  GLU  ASP  GLY  LYS  ALA ...
T C G G T A C A G G T T G G C G A A G A C G G T A A G G C T...
                1690                1700                1710...
                ... THR  ILE  GLN  ASN  GLY  THR  LYS  THR  THR  ASP
                ... A C G A T T C A A A A T G G T A C G A A A A C A A C C G A C
                ...                 1720                1730                1740
                ...

GLY  LEU  VAL  GLU  ALA  SER  GLU  LEU  VAL  GLU ...
G G T T T G G T T G A A G C T T C C G A A T T G G T T G A A...
                1750                1760                1770...
                ... SER  LEU  ASN  LYS  LEU  GLY  TRP  LYS  VAL  GLY
                ... A G C C T G A A C A A A C T G G G C T G G A A A G T G G G C
                ...                 1780                1790                1800
                ...

VAL  ASP  LYS  ASP  GLY  SER  GLY  GLU  LEU  ASP ...
G T T G A T A A A G A C G G G C A G C G G C G A G C T T G A T...
                1810                1820                1830...
                ... GLY  ALA  SER  ASN  GLU  THR  LEU  VAL  LYS  SER
                ... G G T G C A T C C A A T G A A A C T T T A G T G A A G T C G
                ...                 1840                1850                1860
                ...

GLY  ASP  LYS  VAL  THR  LEU  LYS  ALA  GLY  GLU ...
G G C G A T A A A G T A A C T T T G A A A G C C G G C G A G...
                1870                1880                1890...
```

FIG.20J

```
                                                ... ASN LEU LYS VAL LYS GLN ASP GLY THR ASN
                                                ... A A T C T G A A G G T C A A A A C A A G A C G G C A C A A A A C
                                                          1900                    1910                    1920
                                                ...

PHE THR TYR ALA LEU LYS ASP GLU LEU THR ...
T T C A C T T A C G C G C T C A A A G A T G A A T T G A C G...
          1930                    1940...
                                                ... GLY VAL LYS SER VAL GLU PHE LYS ASP THR
                                                ... G G C G T G A A G A G C G T G G A G T T T A A A G A C A C G
                                                ...                     1960                    1970                    1980

ALA ASN GLY SER ASN GLY ALA SER THR LYS ...
G C G A A T G G T T C A A A C G G T G C A A G C A C G A A G...
          1990                    2000...
                                                ... ILE THR LYS ASP GLY LEU THR ILE THR SER
                                                ... A T T A C C A A A G A C G G C T T G A C C A T T A C G T C G
                                                ...                     2020                    2030                    2040

ALA ASN GLY ALA ASN GLY ALA ALA ALA THR ...
G C A A A C G G T G C G A A T G G T G C G G C G G C G A C T...
          2050                    2060...
                                                ... ASP ALA ASP LYS ILE LYS VAL ALA SER ASP
                                                ... G A T G C G G A C A A G A T T A A A G T G G C T T C A G A C
                                                ...                     2080                    2090                    2100
```

FIG.20K

```
GLY  ILE  SER  ALA  GLY  ASN  LYS  ALA  VAL  LYS ...
G G C A T C A G T G C G G G T A A T A A A G C G G T T A A A...
            2110                2120                2130...
                                ... ASN  VAL  VAL  SER  GLY  LEU  LYS  LYS  PHE  GLY
                                ... A A C G T T G T G A G C G G A C T G A A G A A A T T T G G T
                                ...             2140                2150                2160

ASP  ALA  ASN  PHE  ASN  PRO  LEU  THR  SER  SER ...
G A T G C G A A T T T C A A T C C A C T G A C C A G T T C C...
            2170                2180                2190...
                                ... ALA  ASP  ASN  LEU  THR  LYS  GLN  TYR  ASP  ASP
                                ... G C C G A C A A C T T A A C G A A A C A A T A T G A C G A T
                                ...             2200                2210                2220

ALA  TYR  LYS  GLY  LEU  THR  ASN  LEU  ASP  GLU ...
G C C T A T A A A G G C T T G A C C A A T T T G G A T G A A...
            2230                2240                2250...
                                ... LYS  GLY  ALA  ASP  LYS  GLN  THR  LEU  THR  VAL
                                ... A A A G G T G C G G A C A A G C A A A C T C T G A C T G T T
                                ...             2260                2270                2280

ALA  ASP  ASN  THR  ALA  ALA  THR  VAL  GLY  ASP ...
G C C G A C A A T A C T G C C G C A A C C G T G G G C G A T...
            2290                2300                2310...
```

FIG.20L

```
... LEU ARG GLY LEU GLY TRP VAL ILE SER ALA
... T T G C G C G G C T T G G G C T G G T C A T T T C T G C G
...                2320      2330      2340

ASP LYS THR THR GLY GLU LEU ASN LYS GLU ...
G A C A A A A C C A C A G G C G A A C T C A A T A A G G A A...
                2350      2360      2370...

... TYR ASN ALA GLN VAL ARG ASN ALA ASN GLU
... T A C A A C G C G C A A G T G C G T A A C G C C A A T G A A
...                2380      2390      2400

VAL LYS PHE LYS SER GLY ASN GLY ILE HIS ...
G T G A A A T T C A A G A G C G G C A A C G G T A T C C A T...
                2410      2420      2430...

... VAL SER GLY LYS THR VAL ASN GLY ARG ARG
... G T T T C C G G T A A A A C G G T C A A C G G T A G G C G C
...                2440      2450      2460

GLU ILE THR PHE GLU LEU ALA LYS ASP GLU ...
G A A A T T A C T T T T G A A T T G G C T A A A G A C G A A...
                2470      2480      2490...

... ASN ALA ILE ALA PHE GLY TYR GLY SER LYS
... A A T G C C A T T G C T T T C G G T T A T G G C T C A A A A
...                2500      2510      2520
```

FIG.20M

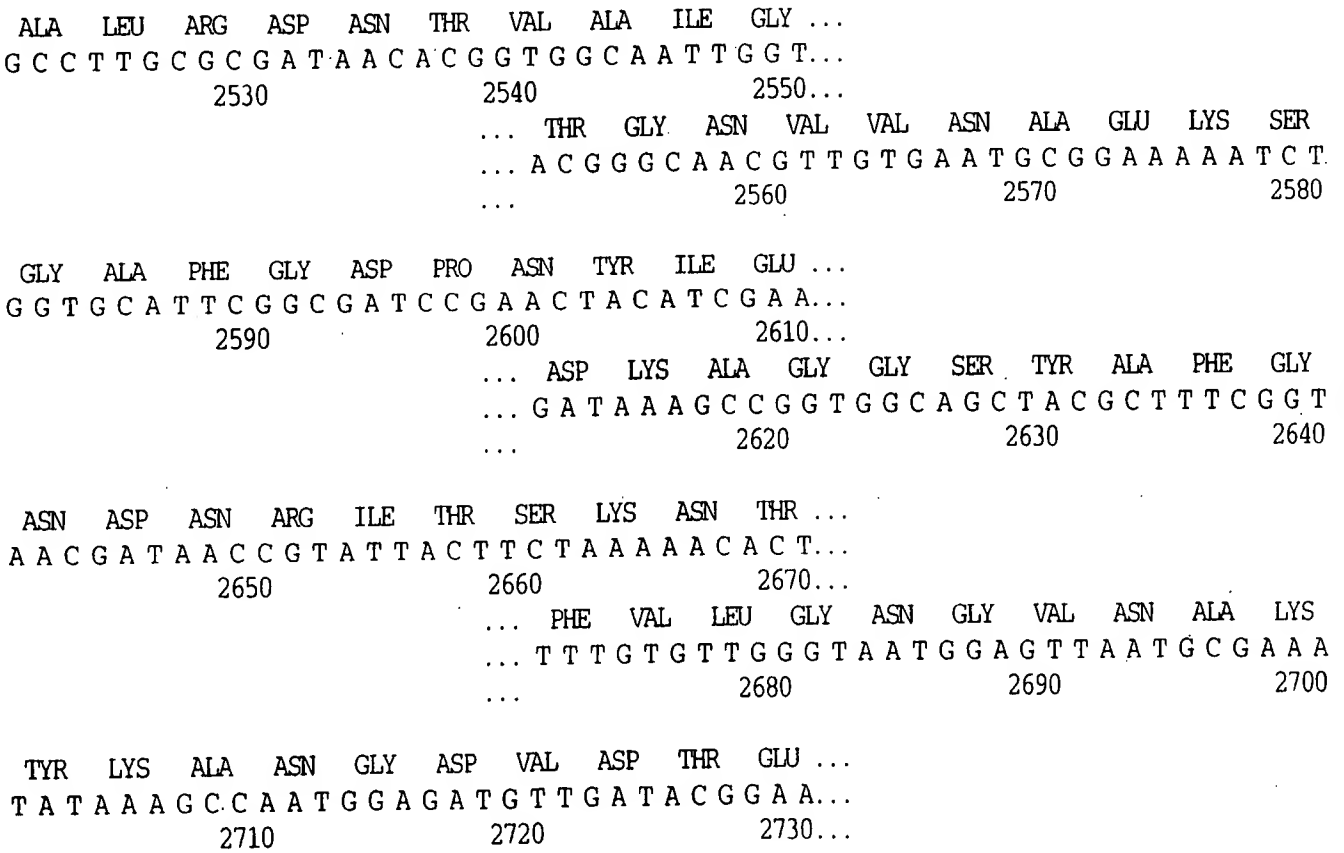

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FIG.20N

```
... THR VAL THR VAL LYS ASP LYS ASP GLY LYS
... A C C G T A A C C G T T A A G G A C A A A G A C G G T A A A
...                2740                2750                2760

GLU THR THR VAL THR VAL PRO LYS ALA LEU ...
G A G A C T A C C G T T A C T G T T C C T A A A G C G T T A...
          2770                2780                2790...

... GLY ALA THR VAL GLU ASN SER VAL TYR LEU
... G G G G C T A C G G T T G A A A A C T C C G T T T A T T T G
...                2800                2810                2820

GLY ASN LYS SER THR ALA THR LYS ASP LYS ...
G G T A A T A A A T C G A C T G C G A C A A A A G A T A A G...
          2830                2840                2850...

... GLY LYS ASN LEU LYS SER ASP GLY THR ALA
... G G T A A A A A A C C C T G A A A A T C T G A T G G T A C G G C G
...                2860                2870                2880

GLY ASN THR THR ALA GLY THR THR GLY ...
G G T A A C A C A C T A C A A C T G C T G G C A C A A C G G G G T...
          2890                2900                2910...

... THR VAL ASN GLY PHE ALA GLY ALA THR ALA
... A C G G T A A A A C G G G C T T T G C C G G G T G C A A C G G C G
...                2920                2930                2940
```

FIG.20O

```
  HIS  GLY  ALA  VAL  SER  VAL  GLY  ALA  SER  GLY ...
C A C G G T G C G G T T C T G T C G G G C G C A A G C G G C...
          2950                 2960                 2970...

  ...  GLU  GLU  ARG  ARG  ILE  GLN  ASN  VAL  ALA  ALA
...G A A G A A A G A C G T A T C C A A A A C G T C G C G G C A
  ...                  2980                 2990                 3000

  GLY  GLU  ILE  SER  ALA  THR  SER  THR  ASP  ALA ...
G G C G A A A T T T C C G C C A C T T C C A C C G A T G C G...
          3010                 3020                 3030...

  ...  ILE  ASN  GLY  SER  GLN  LEU  TYR  ALA  VAL  ALA
...A T T A A C G G G C A G C C A G T T G T A T G C T G T G G C A
  ...                  3040                 3050                 3060

  LYS  GLY  VAL  THR  ASN  LEU  ALA  GLY  GLN  VAL ...
A A A G G G G T A A C A A A T C T T G C T G G A C A A G T G...
          3070                 3080                 3090...

  ...  ASN  LYS  VAL  GLY  LYS  ARG  ALA  ASP  ALA  GLY
...A A T A A A G T G G G C A A A C G T G C A G A T G C A G G T
  ...                  3100                 3110                 3120

  THR  ALA  SER  ALA  LEU  ALA  ALA  SER  GLN  LEU ...
A C A G C A A G T G C A T T A G C A G C T T C A C A G T T A...
          3130                 3140                 3150...
```

FIG.20P

```
                                                                  ... PRO  GLN  ALA  SER  MET  PRO  GLY  LYS  SER  MET
                                                                  ... C C A C A A G C C C T C T A T G C C A G G T A A A T C A A T G
                                                                  ...                                3160                3170                3180

VAL  SER  ILE  ALA  GLY  SER  SER  TYR  GLN  GLY ...
G T T T C T A T T G C G G G A A G T A G T T A T C A A G G T...
                3190                3200                3210...
                                                                  ... GLN  ASN  GLY  LEU  ALA  ILE  GLY  VAL  SER  ARG
                                                                  ... C A A A A T G G T T T A G C T A T C G G G G T A T C A C G A
                                                                  ...                                3220                3230                3240

ILE  SER  ASP  ASN  GLY  LYS  VAL  ILE  ILE  ARG ...
A T T T C C G A T A A T G G C A A A G T G A T T A T T C G C...
                3250                3260                3270...
                                                                  ... LEU  SER  GLY  THR  THR  ASN  SER  GLN  GLY  LYS
                                                                  ... T T G T C A G G C A C A A C C A A T A G C C A A G G T A A A
                                                                  ...                                3280                3290                3300

THR  GLY  VAL  ALA  ALA  GLY  VAL  GLY  TYR  GLN ...
A C A G G C G T T G C A G C A G G T G T T G G T T A C C A G...
                3310                3320                3330...
                                                                  ...  TRP  ***
                                                                  ... T G G T A A T A G A A A T T C C G G A T C C G C
                                                                  ...                                3340                3350
```

FIG.21A

NTHi strain M4071 Hia

```
                    MET  ASN  LYS  ILE  PHE  ASN  VAL...
G C G A A T T C A T A T G A A C A A A A T T T T A A C G T ...
              10                  20                  30 ...
                                  ...  ILE  TRP  ASN  VAL  MET  THR  GLN  THR  TRP  ALA
                                  ...T A T T T G G A A T G T T A T G A C T C A A A C T T G G G C
                                  ...                 40                  50                  60

  VAL  VAL  SER  GLU  LEU  THR  ARG  ALA  HIS  THR...
T G T C G T A T C T G A A C T C A C T C G C G C C C A C A C ...
              70                  80                  90 ...
                                  ...  LYS  ARG  ALA  SER  ALA  THR  VAL  ALA  THR  ALA
                                  ...C A A A C G T G C C T C C G C A A C C G T G G C A A C C G C
                                  ...                 100                 110                 120

  VAL  LEU  ALA  THR  LEU  LEU  SER  THR  THR  VAL...
C G T A T T G G C G A C G T T G T T G T C T A C A A C A G T ...
              130                 140                 150 ...
                                  ...  GLN  ALA  THR  THR  THR  GLY  GLY  THR  THR  SER
                                  ...T C A G G C G A C A A C T A C T G G C G G T A C G A C A A G
                                  ...                 160                 170                 180

  THR  ASN  GLY  LEU  LYS  ALA  TYR  GLY  SER  THR...
T A C A A A C G G T T T G A A A G C T T A T G G A A G T A C ...
              190                 200                 210 ...
```


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FIG.21B

```
...  ASN  ASN  PRO  ASN  PHE  ASN  ALA  ALA  GLY  ASN
...G A A T A A T C C G A A T T T C A A T G C T G C A G G T A A
...                 220                 230                 240

SER  ALA  THR  ASP  LEU  ALA  ARG  GLN  PHE  ASP...
C T C T G C A A C T G A T T T A G C T A G A C A G T T T G A ...
                 250                 260                 270 ...

...  GLY  ALA  TYR  ASP  GLY  LEU  LEU  ASN  LEU  ASN
...T G G T G C T T A T G A C G G T T T A T T A A A T C T A A A
...                 280                 290                 300

GLU  LYS  ASP  ALA  ASN  LYS  ASN  LEU  LEU  VAL...
T G A A A A G A T G C G A A T A A A A A T C T G T T G G T ...
                 310                 320                 330 ...

...  THR  ASP  ASP  LYS  ALA  ALA  THR  VAL  GLY  ASN
...G A C T G A T G A T A A G G C G G C G A C C G T A G G C A A
...                 340                 350                 360

LEU  ARG  LYS  LEU  GLY  TRP  VAL  LEU  SER  SER...
T T T G C G T A A A T T G G G T T G G G T A T T G T C T A G ...
                 370                 380                 390 ...

...  LYS  ASN  GLY  THR  ARG  ASN  GLU  LYS  SER  GLN
...T A A A A A C G G G C A C A A G G A A C G A G A A A A G C C A
...                 400                 410                 420
```

FIG.21C

```
  GLN  VAL  LYS  HIS  ALA  ASP  GLU  VAL  LEU  PHE...
A C A A G T C A A A C A C G C G G A T G A A G T G T T G T T ...
          430                 440                 450 ...

...  GLU  GLY  LYS  ASP  GLY  VAL  THR  VAL  THR  SER
...T G A A G G C A A A G A C G G T G T A A C G G T T A C T T C
...                 460                 470                 480

  LYS  SER  GLU  ASN  GLY  LYS  HIS  THR  VAL  THR...
C A A A T C T G A A A A C G G T A A A C A C A C C G T T A C ...
          490                 500                 510 ...

...  PHE  THR  LEU  GLU  LYS  ASP  LEU  ASN  VAL  LYS
...T T T T A C C C T T G A G A A A G A C C T T A A T G T A A A
...                 520                 530                 540

 ASN  ALA  THR  VAL  SER  ASP  LYS  LEU  SER  LEU...
A A A C G C A A C C C G T T A G C G A T A A A T T A T C G C T ...
          550                 560                 570 ...

...  GLY  ALA  ASN  GLY  ASN  LYS  VAL  ASP  ILE  THR
...T G G T G C A A A C G G C A A T A A A G T C G A T A T T A C
...                 580                 590                 600

 SER  ASP  THR  ASN  GLY  LEU  LYS  PHE  ALA  LYS...
C A G T G A T A C A A A C G G C T T G A A A T T T G C G A A ...
          610                 620                 630 ...
```

FIG.21D

```
                              ...  PRO  SER  THR  ASN  GLY  GLN  ASN  GLY  ASN  VAL
                              ...A C C A A G T A C G A A T G G T C A A A A C G G T A A T G T
                              ...           640                 650                 660

 HIS  LEU  ASN  GLY  ILE  ALA  SER  THR  LEU  THR...
T C A C T T A A A C G G T A T T G C C T C T A C C T T A A C ...
           670                 680                 690 ...
                              ...  ASP  THR  ILE  THR  GLY  THR  THR  LYS  SER  ALA
                              ...T G A C A C A A T T A C A G G T A C A A C A A A A T C T G C
                              ...           700                 710                 720

 THR  ASN  GLY  VAL  ASP  VAL  GLN  ASN  HIS  ASN...
A A C T A A T G G T G T A G A T G T G C A G A A T C A T A A ...
           730                 740                 750 ...
                              ...  ARG  ALA  ALA  SER  VAL  ALA  ASP  VAL  LEU  ASN
                              ...T C G T G C T G C G A G T G T A G C T G A T G T A T T G A A
                              ...           760                 770                 780

 ALA  GLY  TRP  ASN  ILE  GLN  GLY  ASN  GLY  ALA...
T G C A G G C T G G A A T A T T C A A G G C A A C G G A G C ...
           790                 800                 810 ...
                              ...  SER  VAL  ASP  PHE  VAL  ASN  THR  TYR  ASP  THR
                              ...G A G C G T T G A T T T T G T C A A T A C T T A C G A C A C
                              ...           820                 830                 840
```

FIG.21E

```
 VAL  ASP  PHE  VAL  ASN  GLY  LEU  ASN  THR  ASN...
A G T A G A T T T T G T C A A T G G T T T A A A T A C C A A ...
               850                 860                 870 ...
                                ...  VAL  ASN  VAL  THR  THR  ASP  THR  ALA  HIS  ASN
                                ...T G T G A A C G T T A C G A C T G A T A C G G C T C A C A A
                                ...             880                 890                 900

 LYS  LYS  THR  THR  VAL  ARG  VAL  ASP  VAL  THR...
C A A A A A G A C A A C C G T C C G T G T G G A T G T A A C ...
               910                 920                 930 ...
                                ...  GLY  LEU  PRO  VAL  GLN  TYR  VAL  THR  GLU  ASP
                                ...G G G C T T G C C G G T C C A A T A T G T T A C G G A A G A
                                ...             940                 950                 960

 GLY  GLU  THR  VAL  VAL  LYS  VAL  GLY  ASN  GLU...
C G G C G A A A C C G T T G T G A A A G T G G G C A A T G A ...
               970                 980                 990 ...
                                ...  TYR  TYR  GLU  ALA  LYS  GLN  ASP  GLY  SER  ALA
                                ...G T A T T A C G A A G C C A A G C A A G A C G G T T C G G C
                                ...             1000                1010                1020

 ASP  MET  ASP  LYS  LYS  VAL  GLU  ASN  GLY  LYS...
G G A T A T G G A T A A A A A A G T C G A A A A T G G C A A ...
               1030                1040                1050 ...
```

FIG.21F

```
                        ...  LEU  ALA  LYS  THR  LYS  VAL  LYS  LEU  VAL  SER
                        ...G C T G G C G A A A A C T A A A G T T A A A T T G G T A T C
                        ...            1060                1070                1080

 ALA  ASN  GLY  THR  ASN  PRO  VAL  LYS  ILE  SER...
G G C A A A C G G T A C A A A T C C G G T G A A A A T C A G ...
            1090                1100                1110 ...
                        ...  ASN  VAL  ALA  ASP  GLY  THR  GLU  ASN  THR  ASP
                        ...C A A T G T T G C G G A C G G C A C G G A A A A T A C C G A
                        ...            1120                1130                1140

 ALA  VAL  SER  PHE  LYS  GLN  LEU  LYS  ALA  LEU...
T G C G G T C A G C T T T A A G C A G T T G A A A G C C T T ...
            1150                1160                1170 ...
                        ...  GLN  ASP  LYS  GLN  VAL  THR  LEU  SER  ALA  SER
                        ...G C A A G A C A A A C A G G T T A C G T T A A G T G C G A G
                        ...            1180                1190                1200

 ASN  ALA  TYR  ALA  ASN  GLY  GLY  SER  ASP  ALA...
C A A T G C T T A T G C C A A T G G C G G T A G C G A T G C ...
            1210                1220                1230 ...
                        ...  ASP  GLY  GLY  LYS  GLY  ILE  GLN  THR  LEU  SER
                        ...C G A C G G C G G C A A G G G A A T T C A A A C T T T A A G
                        ...            1240                1250                1260
```

FIG.21G

```
   ASN  GLY  LEU  ASN  PHE  LYS  PHE  LYS  SER  THR...
C A A T G G T T T G A A T T T T A A A T T T A A A T C C A C ...
            1270              1280              1290 ...
                                ...  ASP  GLY  GLU  LEU  LEU  ASN  ILE  LYS  ALA  GLU
                                ...A G A C G G C G A G T T G T T G A A T A T C A A A G C A G A
                                ...              1300              1310              1320

   ASN  ASP  THR  VAL  THR  PHE  THR  PRO  LYS  LYS...
A A A T G A C A C G G T T A C C T T T A C G C C G A A A A A ...
            1330              1340              1350 ...
                                ...  GLY  SER  VAL  GLN  VAL  GLY  ASP  ASP  GLY  LYS
                                ...A G G T T C G G T G C A G G T T G G C G A T G A T G G T A A
                                ...              1360              1370              1380

   ALA  THR  ILE  GLN  ASP  GLY  ALA  LYS  THR  THR...
G G C T A C G A T T C A A G A C G G C G C A A A A A C A A C ...
            1390              1400              1410 ...
                                ...  THR  GLY  LEU  VAL  GLU  ALA  SER  GLU  LEU  VAL
                                ...T A C C G G T T T G G T T G A G G C T T C T G A A T T G G T
                                ...              1420              1430              1440

   ASP  SER  LEU  ASN  LYS  LEU  GLY  TRP  LYS  VAL...
T G A C A G C C T G A A C A A A T T G G G T T G G A A A G T ...
            1450              1460              1470 ...
```


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FIG.21H

```
                              ... GLY THR GLY THR ASP GLY THR GLY VAL THR
                              ...G G G C A C C G G C A C T G A C G G C A C A G G A G T G A C
                              ...          1480                1490                1500
ASP GLY THR HIS THR ASP THR LEU VAL LYS...
C G A T G G C A C G C A T A C C G A C A C T T T A G T G A A ...
        1510                1520                1530 ...
                              ... SER GLY ASP LYS VAL THR LEU LYS ALA GLY
                              ...G T C G G G C G A T A A A G T A A C T T T G A A A G C C G G
                              ...          1540                1550                1560
ASP ASN LEU LYS VAL LYS GLN GLU GLY THR...
C G A C A A T C T G A A G G T C A A A C A A G A G G G T A C ...
        1570                1580                1590 ...
                              ... ASN PHE THR TYR ALA LEU LYS ASP GLU LEU
                              ...A A A C T T C A C T T A T G C G C T C A A A G A T G A A T T
                              ...          1600                1610                1620
THR ASP VAL LYS SER VAL GLU PHE LYS ASP...
G A C G G A C G T G A A G A G C G T G G A G T T T A A A G A ...
        1630                1640                1650 ...
                              ... THR ALA ASN GLY ALA ASN GLY ALA SER THR
                              ...C A C G G C G A A T G G T G C A A A C G G T G C A A G C A C
                              ...          1660                1670                1680
```

FIG.21I

```
   LYS  ILE  THR  LYS  ASP  GLY  LEU  THR  ILE  THR...
G A A G A T T A C C A A A G A C G G C T T G A C C A T T A C ...
          1690              1700              1710 ...
                                ...  PRO  ALA  ASN  GLY  ALA  GLY  ALA  ALA  GLY  ALA
                                ...G C C G G C A A A C G G T G C G G G T G C G G C A G G T G C
                                ...            1720              1730              1740

   ASN  THR  ALA  ASN  THR  ILE  SER  VAL  THR  LYS...
A A A C A C T G C A A A C A C C A T T A G C G T A A C C A A ...
          1750              1760              1770 ...
                                ...  ASP  GLY  ILE  SER  ALA  GLY  ASN  LYS  ALA  VAL
                                ...A G A C G G C A T T A G C G C G G G T A A T A A A G C A G T
                                ...            1780              1790              1800

   LYS  ASN  VAL  VAL  SER  GLY  LEU  LYS  LYS  PHE...
T A A A A A C G T T G T G A G C G G A C T G A A G A A A T T ...
          1810              1820              1830 ...
                                ...  GLY  ASP  ALA  ASN  PHE  ASP  PRO  LEU  THR  SER
                                ...T G G T G A T G C G A A T T T C G A T C C G C T G A C T A G
                                ...            1840              1850              1860

   SER  ALA  ASP  ASN  LEU  THR  LYS  GLN  TYR  ASP...
C T C A G C C G A C A A C T T A A C G A A A C A A T A T G A ...
          1870              1880              1890 ...
```


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FIG.21J

```
...  ASN  ALA  TYR  LYS  GLY  LEU  THR  ASN  LEU  ASP
...C A A T G C C T A T A A A G G C T T G A C C A A T C T G G A
...                1900                1910                1920

  GLU  LYS  SER  LYS  GLY  LYS  GLN  THR  PRO  THR...
T G A A A A A A G T A A A G G C A A G C A A A C T C C G A C ...
                1930                1940                1950 ...

...  VAL  ALA  ASP  ASN  THR  ALA  ALA  THR  VAL  GLY
...C G T T G C T G A C A A T A C C G C T G C A A C C G T G G G
...                1960                1970                1980

  ASP  LEU  ARG  GLY  LEU  GLY  TRP  VAL  ILE  SER...
C G A T T T G C G C G G C T T G G G C T G G T C A T T T C ...
                1990                2000                2010 ...

...  ALA  ASP  LYS  THR  LYS  GLY  GLU  LEU  ASN  LYS
...T G C A G A C A A A A C C A A A G G C G A A C T C A A T A A
...                2020                2030                2040

  GLU  TYR  ASN  ALA  GLN  VAL  ARG  ASN  ALA  ASN...
G G A A T A C A A C G C A C A A G T G C G T A A C G C T A A ...
                2050                2060                2070 ...

...  GLU  VAL  LYS  PHE  LYS  SER  GLY  ASN  GLY  ILE
...T G A A G T G A A A T T C A A G A G C G G C A A C G G T A T
...                2080                2090                2100
```

FIG.21K

```
  ASN  VAL  SER  GLY  LYS  THR  LEU  ASP  ASN  GLY...
C A A T G T T T C C G G T A A A A C A T T G G A T A A C G G ...
      2110                 2120                 2130 ...

...  THR  ARG  GLU  ILE  THR  PHE  GLU  LEU  ALA  LYS
...T A C G C G C G A A A A T T A C T T T T G A A T T G G C T A A
...          2140                 2150                 2160

  ASP  GLU  ASN  ALA  ILE  ALA  PHE  GLY  SER  GLY...
A G A C G A A A A A T G C C A T T G C T T T C G G T T C T G G ...
      2170                 2180                 2190 ...

...  SER  LYS  ALA  LEU  ARG  ASP  ASN  THR  VAL  ALA
...C T C A A A A G C C C T T G C G C G A T A A C A C G G T G G C
...          2200                 2210                 2220

  ILE  GLY  THR  GLY  ASN  VAL  VAL  ASN  ALA  GLU...
A A T T G G T A C G G G C A A C G T T G T G A A T G C G G A ...
      2230                 2240                 2250 ...

...  LYS  SER  GLY  ALA  PHE  GLY  ASP  PRO  ASN  TYR
...A A A A T C T G G T G C A T T C G G C G A T C C G A A C T A
...          2260                 2270                 2280

  ILE  GLU  ASP  LYS  ALA  GLY  GLY  SER  TYR  ALA...
C A T C G A A G A T A A A G C C G G T G G C A G C T A C G C ...
      2290                 2300                 2310 ...
```

FIG.21L

```
                        ...  PHE GLY ASN ASP ASN ARG ILE THR SER LYS
                        ...TTTCGGTAACGATAACCGTATTACTTCTAA
                        ...       2320      2330      2340
 ASN THR PHE VAL LEU GLY ASN SER VAL ASN...
AAACACTTTTGTGTTGGGTAATAGTGTTAA ...
       2350      2360      2370 ...
                        ...  ALA LYS ARG ASP ALA ASN GLY ASN VAL LEU
                        ...TGCGAAACGTGATGCAAATGGCAATGTACT
                        ...       2380      2390      2400
 THR GLU GLU LYS GLU VAL VAL GLY LYS ASP...
GACCGAAGAAAAAGAAGTGGTTGGAAAAGA ...
       2410      2420      2430 ...
                        ...  GLY ALA LYS THR LYS VAL THR VAL PRO GLN
                        ...CGGTGCGAAGACGAAAGTAACCGTGCCGCA
                        ...       2440      2450      2460
 ALA LEU GLY GLU THR VAL GLU ASN SER VAL...
AGCCTTAGGCGAAACCGTAGAAAATTCTGT ...
       2470      2480      2490 ...
                        ...  TYR LEU GLY ASN ALA SER THR ALA THR LYS
                        ...TTATCTCGGTAATGCTTCAACTGCGACAAA
                        ...       2500      2510      2520
```

FIG.21M

```
   ASP  LYS  GLY  LYS  ASN  LEU  LYS  SER  ASP  GLY...
A G A T A A G G G T A A A A A C C T G A A A T C T G A T G G ...
            2530              2540              2550 ...
                              ...  THR  ALA  GLY  ASN  THR  THR  THR  ALA  GLY  ALA
                              ...T A C G G C G G G T A A C A C T A C A A C T G C T G G C G C
                              ...            2560              2570              2580

   THR  GLY  THR  VAL  ASN  GLY  PHE  ALA  GLY  ALA...
A A C G G G T A C G G T A A A C G G C T T T G C C G G T G C ...
            2590              2600              2610 ...
                              ...  THR  ALA  HIS  GLY  ALA  VAL  SER  VAL  GLY  ALA
                              ...A A C G G C G C A C G G T G C G G T T T C T G T C G G C G C
                              ...            2620              2630              2640

   SER  GLY  GLU  GLU  ARG  ARG  ILE  GLN  ASN  VAL...
A A G T G G C G A A G A A A G A C G T A T C C A A A A C G T ...
            2650              2660              2670 ...
                              ...  ALA  ALA  GLY  GLU  ILE  SER  ALA  THR  SER  THR
                              ...C G C G G C A G G C G A A A T T T C C G C T A C T T C C A C
                              ...            2680              2690              2700

   ASP  ALA  ILE  ASN  GLY  SER  GLN  LEU  TYR  ALA...
A G A T G C G A T T A A C G G T A G C C A G T T G T A T G C ...
            2710              2720              2730 ...
```

FIG.21N

```
                                        ...  VAL  ALA  LYS  GLY  VAL  THR  ASN  LEU  ALA  GLY
                                        ...T G T G G C A A A A G G G G T A A C A A A C C T T G C T G G
                                        ...              2740              2750              2760

  GLN  VAL  ASN  LYS  VAL  GLY  LYS  ARG  ALA  ASP...
A C A A G T G A A T A A A G T G G G C A A A C G T G C A G A ...
            2770              2780              2790 ...
                                        ...  ALA  GLY  THR  ALA  SER  ALA  LEU  ALA  ALA  SER
                                        ...T G C A G G T A C A G C A A G T G C A T T A G C G G C T T C
                                        ...              2800              2810              2820

  GLN  LEU  PRO  GLN  ALA  SER  MET  PRO  GLY  LYS...
A C A G T T A C C A C A A G C C T C T A T G C C A G G T A A ...
            2830              2840              2850 ...
                                        ...  SER  MET  VAL  SER  ILE  ALA  GLY  SER  SER  TYR
                                        ...A T C A A T G G T T T C T A T T G C G G G A A G T A G T T A
                                        ...              2860              2870              2880

  GLN  GLY  GLN  SER  GLY  LEU  ALA  ILE  GLY  VAL...
T C A A G G T C A A A G T G G T T T A G C T A T C G G G G T ...
            2890              2900              2910 ...
                                        ...  SER  ARG  ILE  SER  ASP  ASN  GLY  LYS  VAL  ILE
                                        ...A T C A A G A A T T T C C G A T A A T G G C A A A G T G A T
                                        ...              2920              2930              2940
```

FIG.21O

```
   ILE  ARG  LEU  SER  GLY  THR  THR  ASN  SER  GLN...
T A T T C G C T T G T C A G G C A C A A C C A A T A G C C A ...
                2950      2960      2970 ...

...  GLY  LYS  THR  GLY  VAL  ALA  ALA  GLY  VAL  GLY
...A G G T A A A A C A G G C G T T G C A G C A G G T G T T G G
                2980      2990      3000
...

   TYR  GLN  TRP  ***  ***  ASN  SER  GLY  SER
T T A C C A G T G G T A A T A G A A T T C C G G A T C C G C
                3010      3020      3030
```

FIG.22A

NTHi strain K9 hia sequence

```
MET  ASN  LYS  ILE  PHE  ASN  VAL  ILE  TRP  ASN ...
A T G A A C A A A A T T T T A A C G T T A T T G G A A T...
                10                  20                  30...

...  VAL  MET  THR  GLN  THR  TRP  ALA  VAL  VAL  SER
... G T T A T G A C T C A A A C T T G G G C T G T C G T A T C T
...                 40                  50                  60

GLU  LEU  THR  ARG  ALA  HIS  THR  LYS  ARG  ALA ...
G A A C T C A C T C G C G C C C A C A C C A A A C G T G C C...
                70                  80                  90...

...  SER  ALA  THR  VAL  ALA  THR  ALA  VAL  LEU  ALA
... T C C G C A A C C G T G G C G A C C G C C G T A T T G G C G
...                 100                 110                 120

THR  GLN  LEU  SER  ALA  THR  ALA  GLU  ALA  ASN ...
A C G C A G T T G T C T G C A A C G G C T G A A G C G A A C...
                130                 140                 150...

...  SER  SER  ALA  SER  VAL  THR  SER  ARG  LEU  ASN
... A G T A G T G C T T C T G T T A C G A G T A G G T T G A A T
...                 160                 170                 180

VAL  TYR  GLY  ASP  THR  ASN  THR  LYS  PHE  ASN ...
G T T T A T G G C G A T A C G A A T A C T A A A T T C A A T...
                190                 200                 210...
```

FIG.22B

```
... ALA  ALA  ASN  ASN  SER  ILE  ALA  ASP  LEU  ASN
... G C A G C C A A T A A T T C A A T A G C A G A T T T A A A T
...                 220                 230                 240

LYS  GLN  ASN  ASP  GLY  VAL  HIS  ASP  GLY  LEU ...
A A A C A A A A T G A T G G T G T T C A C G A T G G T T T A...
                 250                 260                 270...

... LEU  ASN  LEU  ASN  GLU  ASN  GLY  ALA  ASN  LYS
... T T A A A T C T G A A T G A A A A C G G T G C G A A T A A A
...                 280                 290                 300

LYS  LEU  LEU  VAL  ASP  ASP  ASN  THR  ALA  ALA ...
A A G C T G T T G G T G G A T G A C A A T A C T G C G G C G...
                 310                 320                 330...

... THR  VAL  GLY  ASP  LEU  ARG  LYS  LEU  GLY  TRP
... A C C G T A G G C G A T T T A C G T A A A T T G G G C T G G
...                 340                 350                 360

VAL  VAL  SER  THR  LYS  ASN  GLY  LYS  GLU  ASN ...
G T C G T A T C A A C C A A A A A A T G G C A A G G A A A A T...
                 370                 380                 390...

... GLU  LYS  SER  GLN  GLN  VAL  LYS  GLN  ALA  ASP
... G A G A A A A A G C C C A A C A A G T C A A A A C A G G C G G A T
...                 400                 410                 420
```

FIG.22C

```
GLU   VAL   LEU   PHE   LYS   GLY   SER   LYS   GLY   GLY ...
G A A G T G T T G T T T A A A G G C A G C A A A G G C G G T...
                  430                 440                 450...
                                     ... VAL   GLN   VAL   THR   SER   THR   SER   GLU   ASN   GLY
                                     ... G T G C A G G T T A C T T C C A C C T C T G A A A A C G G C
                                     ...                 460                 470                 480

LYS   HIS   ALA   ILE   THR   PHE   ALA   LEU   ALA   LYS ...
A A A C A C G C C A T T A C C T T T G C T T T A G C G A A A...
                  490                 500                 510...
                                     ... ASP   LEU   ASP   MET   ARG   THR   ALA   THR   VAL   SER
                                     ... G A C C T T G A T A T G A G A A C T G C G A C T G T G A G T
                                     ...                 520                 530                 540

ASP   THR   LEU   THR   ILE   GLY   GLY   SER   THR   THR ...
G A T A C C T T A A C G A T T G G C G G T A G T A C T A C T...
                  550                 560                 570...
                                     ... THR   GLY   SER   ALA   THR   THR   PRO   LYS   VAL   ASN
                                     ... A C A G G T A G T G C A A C A A C A C C A A A A G T G A A T
                                     ...                 580                 590                 600

VAL   THR   SER   THR   ALA   SER   GLY   LEU   ASN   PHE ...
G T G A C T A G C A C G G C A A G C G G C T T G A A C T T T...
                  610                 620                 630...
```

FIG.22D

```
                              ... ALA  LYS  GLY  ALA  THR  GLY  ALA  ASN  GLY  ASP
                              ... G C G A A A G G C G C T A C A G G T G C T A A T G G C G A T
                              ...              640                 650                 660

THR  THR  VAL  HIS  LEU  THR  ASN  ILE  ALA  SER ...
A C T A C G G T T C A C T T G A C T A A T A T T G C T T C A...
             670                 680                 690...
                              ... THR  LEU  GLN  ASP  THR  LEU  LEU  ASN  THR  GLY
                              ... A C T T T G C A A G A T A C T C T A T T G A A T A C T G G G
                              ...              700                 710                 720

VAL  VAL  SER  LYS  LEU  ASP  GLY  ASN  GLY  ILE ...
G T T G T G A G T A A A T T A G A T G G T A A T G G T A T T...
             730                 740                 750...
                              ... THR  ALA  ASP  GLU  LYS  LYS  ARG  ALA  ALA  SER
                              ... A C T G C T G A C G A G A A A A A A C G T G C G G C A A G C
                              ...              760                 770                 780

VAL  GLN  ASP  VAL  LEU  ASN  SER  GLY  TRP  ASN ...
G T T C A A G A T G T T T T A A A T A G T G G T T G G A A T...
             790                 800                 810...
                              ... ILE  LYS  GLY  VAL  LYS  THR  GLY  ALA  THR  THR
                              ... A T C A A G G G T G T T A A A A C A G G T G C G A C G A C T
                              ...              820                 830                 840
```

FIG.22E

```
 SER  ASP  ASN  VAL  ASP  PHE  VAL  ARG  THR  TYR ...
T C T G A T A A C G T T G A T T T T G T C C G T A C T T A C...
          850                 860                 870...
                                ... ASP  THR  VAL  GLU  PHE  LEU  SER  GLY  SER  GLU
                                ... G A C A C A G T T G A G T T T T T G A G C G G A A G T G A A
                                ...          880                 890                 900

 GLU  THR  THR  LEU  VAL  THR  VAL  ASP  SER  GLU ...
G A A A C T A C A C T G G T T A C A G T G G A T A G T G A A...
          910                 920                 930...
                                ... SER  ASN  GLY  LYS  SER  THR  LYS  VAL  LYS  ILE
                                ... A G T A A T G G A A A A T C T A C T T A A A G T T A A A A T C
                                ...          940                 950                 960

 GLY  ALA  LYS  THR  SER  VAL  ILE  LYS  GLU  LYS ...
G G T G C G A A G A C C T C T G T T A T C A A A G A A A A A...
          970                 980                 990...
                                ... ASP  GLY  LYS  LEU  PHE  THR  GLY  LYS  ALA  ASN
                                ... G A C G G T A A G T T A T T T A C T G G A A A A G C T A A T
                                ...          1000                1010                1020

 LYS  ASP  THR  ASN  GLN  VAL  ALA  SER  ASN  ASN ...
A A A G A C A C A A A T C A A G T C G C A A G T A A T A A T...
          1030                1040                1050...
```

FIG.22F

```
... ALA ALA ASP ASP THR ASP GLU GLY LYS GLY
... G C A G C T G A T G A T A C G G A T G A G G G C A A A G G C
...                1060                1070                1080

LEU VAL THR ALA GLU THR VAL ILE ASN ALA ...
T T A G T C A C T G C A G A G A C T G T T A T C A A T G C A...
          1090                1100                1110...

... VAL ASN LYS ALA GLY TRP ARG ILE LYS THR
... G T A A A C A A G G C T G G T T G G A G A A T T A A A A C A
...                1120                1130                1140

THR GLY ALA ASN ASN GLN ALA GLY GLN PHE ...
A C G G G T G C T A A T A A T C A A G C T G G T C A G T T T T...
          1150                1160                1170...

... GLU THR VAL THR SER GLY THR ASN VAL THR
... G A A A C T G T C A C A T C A G G C A C A A A T G T A A C C
...                1180                1190                1200

PHE ALA ASP GLY ASN GLY THR THR ALA VAL ...
T T T G C T G A T G G C A A T G G T A C A A C T G C A G T C...
          1210                1220                1230...

... VAL THR GLY ASP ALA THR ASN GLY ILE THR
... G T A A C T G G C G A T G C T A C C A A T G G T A T T A C T
...                1240                1250                1260
```

FIG.22G

```
 VAL  LYS  TYR  GLU  ALA  LYS  VAL  GLY  ASP  GLY ...
 GTTAAATACGAAGCGAAAGTTGGCGACGGC...
      1270                1280                1290...

 ...  LEU  LYS  ILE  GLY  ASN  ASP  GLN  LYS  ILE  THR
 ...TTGAAGATTGGTAACGACCAAAAATCACT
 ...                 1300                1310                1320

 ALA  ASP  THR  THR  ALA  LEU  THR  VAL  THR  GLY ...
 GCAGATACGACCGCACTTACTGTGACGGGC...
           1330                1340                1350...

 ...  GLY  LYS  VAL  THR  ALA  PRO  ASP  ALA  THR  ASN
 ...GGTAAAGTTACTGCCCCCTGATGCAACCAAT
 ...                 1360                1370                1380

 GLY  LYS  LEU  VAL  ASN  ALA  SER  GLY  LEU ...
 GGTAAGAAACTTGTTAATGCAAGTGGTTTA...
           1390                1400                1410...

 ...  ALA  ASP  ALA  LEU  ASN  LYS  LEU  SER  TRP  THR
 ...GCTGATGCGTTAAACAAATTAAGTTGGACT
 ...                 1420                1430                1440

 ALA  LYS  ALA  GLU  ALA  ASP  THR  ALA  ASN  GLY ...
 GCAAAAAGCTGAAGCAGATACTGCTAATGGC...
           1450                1460                1470...
```

FIG.22H

```
                                    ... GLY  GLU  LEU  ASP  GLY  THR  ALA  ASP  GLU  LYS
                                    ... G G C G A G C T T G A T G G A A C T G C A G A T G A A A A A
                                    ...              1480              1490              1500

 GLU  VAL  LYS  ALA  GLY  GLU  THR  VAL  THR  PHE ...
G A A G T T A A A G C A G G C G A A A C G G T A A C C T T T...
            1510              1520              1530...
                                    ... LYS  ALA  GLY  LYS  ASN  LEU  LYS  VAL  LYS  GLN
                                    ... A A A G C G G G C A A G A A C T T A A A A G T G A A A C A A
                                    ...              1540              1550              1560

 ASP  GLY  ALA  ASN  PHE  THR  TYR  SER  LEU  GLN ...
G A T G G T G C G A A C T T T A C T T A T T C A C T G C A A...
            1570              1580              1590...
                                    ... ASP  ALA  LEU  THR  GLY  LEU  THR  SER  ILE  THR
                                    ... G A T G C T T T A A C A G G C T T A A C G A G C A T T A C T
                                    ...              1600              1610              1620

 LEU  GLY  THR  GLY  ASN  ASN  GLY  ALA  LYS  THR ...
T T A G G T A C A G G A A A T A A T G G T G C G A A A A C T...
            1630              1640              1650...
                                    ... GLU  ILE  ASN  LYS  ASP  GLY  LEU  THR  ILE  THR
                                    ... G A A A T C A A C A A A G A C G G C T T A A C C A T C A C A
                                    ...              1660              1670              1680
```


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FIG.22I

```
PRO  ALA  ASN  GLY  ALA  GLY  ALA  ASN  ASN  ALA ...
C C A G C A A A T G G T G C G G G T G C A A A T A A T G C A...
               1690                1700                1710...
                              ... ASN  THR  ILE  SER  VAL  THR  LYS  ASP  GLY  ILE
                              ... A A C A C C A T C A G C G T A A C C A A A G A C G G C A T T
                              ...           1720                1730                1740

SER  ALA  GLY  GLY  GLN  SER  VAL  LYS  ASN  VAL ...
A G T G C G G G C G G T C A G T C G G T T A A A A A C G T T...
               1750                1760                1770...
                              ... VAL  SER  GLY  LEU  LYS  LYS  PHE  GLY  ASP  ALA
                              ... G T G A G C G G A C T G A A G A A A T T T G G T G A T G C G
                              ...           1780                1790                1800

ASN  PHE  ASP  PRO  LEU  THR  SER  SER  ALA  ASP ...
A A T T T C G A T C C G C T G A C T A G C T C C G C C G A C...
               1810                1820                1830...
                              ... ASN  LEU  THR  LYS  GLN  TYR  ASP  ASP  ALA  TYR
                              ... A A C T T A A C G A A A C A A T A T G A C G A T G C C T A T
                              ...           1840                1850                1860

LYS  GLY  LEU  THR  ASN  LEU  ASP  GLU  LYS  GLY ...
A A A G G C T T G A C C A A T T T G G A T G A A A A A G G T...
               1870                1880                1890...
```

FIG.22J

```
... ALA ASP LYS GLN THR LEU THR VAL ALA ASP
... G C G G A C A A G C A A A C T C T G A C T G T T G C C G A C
...                1900                1910                1920

ASN THR ALA ALA THR VAL GLY ASP LEU ARG ...
A A T A C T G C C G C A A C C G T G G G C G A T T T G C G C...
                1930                1940                1950...

... GLY LEU GLY TRP VAL ILE SER ALA ASP LYS
... G G C T T G G G G C T G G G T C A T T T C T G C G G A C A A A
...                1960                1970                1980

THR THR GLY GLU LEU ASP LYS GLU TYR ASN ...
A C C A C A G G C G A A C T C G A T A A G G A A T A C A A C...
                1990                2000                2010...

... ALA GLN VAL ARG ASN ALA ASN GLU VAL LYS
... G C G C A A G T G C G T A A C G C C A A T G A A G T G A A A A
...                2020                2030                2040

PHE LYS SER GLY ASN GLY ILE ASN VAL SER ...
T T C A A A A G C G G C A A C G G T A T C A A T G T T T C C...
                2050                2060                2070...

... GLY LYS THR VAL ASN GLY ARG ARG GLU ILE
... G G T A A A A C T G T C A A C G G T A G G C G T G A A A T T
...                2080                2090                2100
```

FIG.22K

```
  THR  PHE  GLU  LEU  ALA  LYS  GLY  GLU  VAL  VAL ...
A C T T T T G A A T T G G C T A A A G G C G A A G T G G T T...
                2110                2120                2130...

...  LYS  SER  ASN  GLU  PHE  THR  VAL  LYS  GLU  THR
... A A A T C G A A T G A A T T T A C T G T C A A A G A A A C C
...                 2140                2150                2160

 ASN  GLY  LYS  GLU  THR  SER  LEU  VAL  LYS  VAL ...
A A T G G C A A G G A A A C G A G C C T G G T T A A A G T T...
                2170                2180                2190...

...  GLY  ASP  LYS  TYR  TYR  SER  LYS  GLU  ASP  ILE
... G G C G A T A A A T A T T A C A G C A A A G A G G A T A T T
...                 2200                2210                2220

 ASP  PRO  ALA  THR  GLY  LYS  PRO  LYS  VAL  THR ...
G A C C C C A G C A A C C C G G T A A A A C C G A A A G T T A C A...
                2230                2240                2250...

...  ASN  GLY  ASN  ALA  VAL  ALA  ALA  LYS  TYR  GLN
... A A T G G C A A T G C A G T T G C T G C G A A A T A T C A A
...                 2260                2270                2280

 ASP  LYS  ASP  GLY  LYS  VAL  VAL  SER  ALA  ASP ...
G A T A A A G A T G G C A A A G T C G T T T C T G C T G A C...
                2290                2300                2310...
```

FIG.22L

```
... GLY SER SER ASN THR ALA VAL THR LEU THR
... G G C A G C A A T A C C G C T G T T A C C C T A A C C
..                2320      2330      2340

ASN LYS GLY TYR GLY TYR VAL THR GLY ASN ...
A A C A A A G G T T A T G G C T A T G T A A C A G G T A A C...
          2350      2360      2370...

... GLN VAL ALA ASP ALA ILE ALA LYS SER GLY
.... C A A G T G G C A G A T G C G A T T G C G A A A T C A G G C
..                2380      2390      2400

PHE GLU LEU GLY LEU ALA ASP ALA GLU LYS ...
T T T G A G C C T T G G T T T G G C T G A T G C A G A A A A A A...
          2410      2420      2430...

... ALA LYS ALA ALA PHE GLY ASP GLU THR LYS
... G C G A A A G C T G C G T T T G G C G A T G A A A C A A A A A
..                2440      2450      2460

ALA LEU SER SER ASP LYS LEU GLU THR VAL ...
G C C T T G T C T T C T G A T A A A A T T G G A A A C C G T A...
          2470      2480      2490...

... ASN ALA ASN ASP LYS VAL ARG PHE ALA ASN
... A A T G C C A A C G A C A A A G T C C G T T T T G C T A A T
..                2500      2510      2520
```

FIG.22M

```
GLY LEU ASN THR LYS VAL SER ALA ALA THR ...
GGTTTAAATACCAAAGTGAGCGCGGCAACG...
        2530      2540      2550...
... VAL GLU SER ILE ASP ALA ASN GLY ASP LYS
... GTGGAAAGCATCGATGCAAACGGCGATAAA
...       2560      2570      2580

VAL THR THR THR PHE VAL LYS THR ASP VAL ...
GTGACTACAACCTTTGTGAAAACCGATGTG...
        2590      2600      2610...
... GLU LEU PRO LEU THR GLN ILE TYR ASN THR
... GAATTGCCTTTAACGCAAATCTACAATACC
...       2620      2630      2640

ASP ALA ASN GLY LYS LYS ILE VAL LYS ASN ...
GATGCAAACGGTAAGAAAATCGTTAAAAAT...
        2650      2660      2670...
... GLY ASP LYS TRP TYR TYR THR LYS ASP ASP
... GGCGATAAATGGTATTACACGAAAGATGAC
...       2680      2690      2700

GLY SER THR ASP MET THR LYS GLU VAL THR ...
GGCTCAACTGATATGACTAAAGAAGTTACC...
        2710      2720      2730...
```

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FIG.22N

```
                                       ... LEU  GLY  ASN  VAL  ASP  SER  ASP  GLY  LYS  LYS
                                       ... C T T G G C A A T G T G G A T T C A G A C G G C A A G A A A
                                       ...          2740           2750           2760
VAL  VAL  LYS  GLU  ASP  ASN  LYS  TRP  TYR  HIS ...
G T T G T G A A A G A A G A C A A C A A G T G G T A T C A C...
        2770           2780           2790...
                                       ... VAL  LYS  SER  ASP  GLY  SER  THR  ASP  LYS  THR
                                       ... G T T A A A T C T G A T G G T T C T A C G G A T A A A A C A
                                       ...          2800           2810           2820
GLN  VAL  VAL  GLU  GLU  ALA  LYS  VAL  SER  THR ...
C A G G T G G T C G A A G A A G C T A A A G T T T C T A C C...
        2830           2840           2850...
                                       ... ASP  GLU  LYS  HIS  VAL  VAL  SER  LEU  ASP  PRO
                                       ... G A T G A A A A A C A C G T T G T C A G C C T T G A T C C A
                                       ...          2860           2870           2880
ASN  ASP  GLN  SER  LYS  GLY  LYS  GLY  VAL  VAL ...
A A T G A T C A A T C A A A A G G T A A A G G C G T G G T C...
        2890           2900           2910...
                                       ... ILE  ASN  ASN  MET  ALA  ASN  GLY  GLU  ILE  SER
                                       ... A T T A A C A A T A T G G C T A A T G G C G A A A T T T C T
                                       ...          2920           2930           2940
```

FIG.22O

```
 ALA  THR  SER  THR  ASP  ALA  ILE  ASN  GLY  SER ...
 GCCACTTCCACCGATGCGATTAACGGAAGT...
      2950      2960      2970...

 ...  GLN  LEU  TYR  ALA  VAL  ALA  LYS  GLY  VAL  THR
 ...CAGTTGTATGCCGTGGCAAAAGGGGTAACA
 ...       2980      2990      3000

 ASN  LEU  ALA  GLY  GLN  VAL  ASN  ASN  LEU  GLU ...
 AACCTTGCTGGACAAGTGAATAATCTTGAG...
      3010      3020      3030...

 ...  GLY  LYS  VAL  ASN  LYS  VAL  GLY  LYS  ARG  ALA
 ...GGCAAAGTGAATAAAGTGGGCAAACGTGCA
 ...       3040      3050      3060

 ASP  ALA  GLY  THR  ALA  SER  ALA  LEU  ALA  ALA ...
 GATGCAGGTACTGCAAGTGCATTAGCGGCT...
      3070      3080      3090...

 ...  SER  GLN  LEU  PRO  GLN  ALA  THR  MET  PRO  GLY
 ...TCACAGTTACCCACAAGCCACTATGCCAGGT
 ...       3100      3110      3120

 LYS  SER  MET  VAL  SER  ILE  ALA  GLY  SER  SER ...
 AAATCAATGGTTCTATTGCGGGAAGTAGT...
      3130      3140      3150...
```

FIG.22P

```
... TYR GLN GLY GLN ASN GLY LEU ALA ILE GLY
... T A T C A A G G T C A A A A T G G T T T A G C T A T C G G G
                3160                3170                3180
...

VAL SER ARG ILE SER ASP ASN GLY LYS VAL ...
G T A T C A A G A A T T T C C G A T A A T G G C A A A G T G...
        3190                3200                3210...

... ILE ILE ARG LEU SER GLY THR THR ASN SER
... A T T A T T C G C T T G T C A G G C A C A A C C A A T A G T
                3220                3230                3240
...

GLN GLY LYS THR GLY VAL ALA ALA GLY VAL ...
C A A G G T A A A A C A G G C G T T G C A G C A G G T G T T...
        3250                3260                3270...

... GLY TYR GLN TRP ***
... G G T T A C C A G T G G T A A T A G A A T T C C G G A T C C
                3280                3290                3300
...
```

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FIG.23A

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```
                     MET  ASN  LYS  ILE  PHE  ASN...
 G C G A A T T C A T A T G A A C A A A A T T T T T A A ...
                 10                 20                ...
                                      ...  VAL  ILE  TRP  ASN  VAL  VAL  THR  GLN  THR  TRP  VAL
                                      ...C G T T A T T T G G A A T G T T G T G A C T C A A A C T T G G G T
                                      ...  30                 40                 50                 60

  VAL  VAL  SER  GLU  LEU  THR  ARG  ALA  HIS...
 T G T C G T A T C T G A A C T C A C T C G C G C C C A ...
                 70                 80                ...
                                      ...  THR  LYS  CYS  ALA  SER  ALA  THR  VAL  ALA  VAL  ALA
                                      ...C A C C A A A T G C G C C T C C G C C A C C G T G G C G G T T G C
                                      ...  90                 100                110                120

  VAL  LEU  ALA  THR  ALA  LEU  SER  ALA  THR...
 C G T A T T G G C A A C T G C G T T G T C T G C A A C ...
                 130                140               ...
                                      ...  ALA  GLU  ALA  ASN  ASN  ASN  THR  SER  VAL  THR  ASN
                                      ...G G C T G A A G C G A A C A A C A A T A C T T C T G T T A C G A A
                                      ...  150                160                170                180
```

FIG.23B

```
   GLY   LEU   ASN   ALA   TYR   GLY   ASP   THR   ASN...
T G G G T T G A A T G C T T A T G G C G A T A C T A A ...
              190                 200               ...
                                ...   PHE   ASN   THR   THR   ASN   ASN   SER   ILE   ALA   ASP   LEU
                                ...T T T T A A T A C A A C C A A T A A T T C G A T A G C A G A T T T
                                ...  210                 220                 230                 240

   GLU   LYS   HIS   VAL   GLN   ASP   ALA   TYR   LYS...
G G A A A A A C A C G T T C A A G A T G C T T A T A A ...
              250                 260               ...
                                ...   GLY   LEU   LEU   ASN   LEU   ASN   GLU   LYS   ASP   THR   ASN
                                ...A G G C T T A T T A A A T C T G A A T G A A A A A G A T A C A A A
                                ...  270                 280                 290                 300

   LYS   SER   SER   PHE   LEU   VAL   ALA   ASP   ASN...
T A A G T C A A G T T T C T T G G T T G C C G A C A A ...
              310                 320               ...
                                ...   THR   ALA   ALA   THR   VAL   GLY   ASN   LEU   ARG   LYS   LEU
                                ...T A C C G C C G C A A C C G T A G G C A A T T T G C G T A A A T T
                                ...  330                 340                 350                 360

   GLY   TRP   VAL   LEU   SER   SER   LYS   ASN   GLY...
G G G C T G G G T A T T G T C T A G C A A A A A C G G ...
              370                 380               ...
```

FIG.23C

```
...   THR  ARG  ASN  GLU  LYS  SER  TYR  GLN  VAL  LYS  GLN
...C A C A A G G A A C G A G A A A A G C T A T C A A G T A A A A C A
...  390                 400                 410                 420

  ALA  ASP  GLU  VAL  LEU  PHE  THR  GLY  SER...
A G C T G A T G A A G T T C T C T T T A C T G G A T C ...
                430                 440
                                    ...
...   GLY  ALA  ALA  THR  VAL  SER  SER  SER  SER  LYS  ASP
...T G G T G C T G C A A C G G T T A G T T C C A G C T C T A A A G A
...  450                 460                 470                 480

  GLY  LYS  HIS  THR  ILE  THR  ILE  SER  VAL...
C G G T A A A C A T A C C A T T A C C A T T T C T G T ...
                490                 500
                                    ...
...   THR  LYS  GLY  SER  PHE  ALA  GLU  VAL  LYS  THR  ASP
...T A C C A A A G G T A G T T T T G C T G A G G T A A A A A C T G A
...  510                 520                 530                 540

  ALA  THR  THR  GLY  GLY  GLN  VAL  ASN  ALA...
T G C A A C T A C T G G A G G T C A A G T A A A C G C ...
                550                 560
                                    ...
...   ASP  ARG  GLY  LYS  VAL  LYS  ALA  GLU  ASP  GLU  ASN
...C G A C C G T G G T A A A A G T G A A A A G C T G A G G A C G A G A A
...  570                 580                 590                 600
```

FIG.23D

```
   GLY  ALA  ASP  VAL  ASP  LYS  LYS  VAL  ALA...
TGGAGCTGATGTTGATAAGAAAGTTGC...
            610            620            ...
                                  ...  THR  VAL  LYS  ASP  VAL  ALA  LYS  ALA  ILE  ASN  ASP
                                  ...AACTGTAAAAGATGTTGCTAAGGCGATTAACGA
                                  ...  630            640            650            660

   ALA  ALA  THR  PHE  VAL  LYS  VAL  GLU  SER...
TGCCGCAACTTTCGTGAAAGTGGAAAG...
            670            680            ...
                                  ...  THR  ASP  ASP  ASP  ILE  GLU  ASN  GLY  ALA  ALA  GLY
                                  ...CACAGATGATGACATTGAAAATGGTGCTGCAGG
                                  ...  690            700            710            720

   LYS  ASN  GLU  THR  THR  ASP  GLN  ALA  LEU...
CAAAAATGAAACTACAGACCAAGCTCT...
            730            740            ...
                                  ...  LYS  ALA  GLY  ASP  THR  LEU  THR  LEU  LYS  ALA  GLY
                                  ...CAAAGCAGGCGACACCTTAACCTTAAAAGCGGG
                                  ...  750            760            770            780

   LYS  ASN  LEU  LYS  ALA  LYS  LEU  ASP  GLN...
TAAAAACTTAAAAGCTAAGTTAGACCA...
            790            800            ...
```


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FIG.23E

```
...   ASN  GLY  LYS  SER  VAL  THR  PHE  ALA  LEU  ALA  LYS
...A A A T G G T A A A T C A G T A A C C T T T G C T T T A G C G A A
...   810          820          830          840

ASP  LEU  ASP  VAL  THR  SER  ALA  LYS  VAL...
A G A C C T T G A T G T G A C C T C T G C G A A A G T ...
          850          860          ...
...   SER  ASP  LYS  LEU  SER  ILE  GLY  LYS  ASP  THR  ASN
...G A G T G A T A A G T T G T C T A T T G G T A A A G A T A C G A A
...   870          880          890          900

LYS  VAL  ASP  ILE  THR  SER  ASP  ALA  ASN...
T A A A G T T G A T A T T A C C A G T G A T G C A A A ...
          910          920          ...
...   GLY  LEU  LYS  LEU  ALA  LYS  THR  GLY  ASN  GLY  ASN
...T G G C T T G A A A T T G G C G A A A A C A G G T A A C G G A A A
...   930          940          950          960

GLY  GLN  ASN  GLY  ASN  VAL  HIS  LEU  ASN...
T G G T C A A A A C G G T A A T G T C C A C T T A A A ...
          970          980          ...
...   GLY  ILE  ALA  SER  THR  LEU  THR  ASP  THR  ILE  THR
...T G G T A T T G C T T C G A C T T T G A C C G A T A C C A T T A C
...   990          1000          1010          1020
```

FIG.23F

```
GLY  MET  THR  THR  GLN  ALA  SER  ASN  GLY...
A G G T A T G A C A A C A C A A G C A A G C A A T G G ...
          1030                1040                ...
                           ...  VAL  ALA  VAL  GLN  ASN  HIS  ASN  ARG  ALA  ALA  SER
                           ...C G T G G C T G T G C A G A A T C A T A A T C G T G C T G C G A G
                           ... 1050                1060                1070                1080

VAL  ALA  ASP  VAL  LEU  ASN  ALA  GLY  TRP...
T G T G G C T G A T G T A T T A A A T G C A G G C T G ...
          1090                1100                ...
                           ...  ASN  ILE  GLN  GLY  ASN  GLY  ALA  SER  VAL  ASP  PHE
                           ...G A A T A T T C A A G G C A A C G G A G C G A G C G T T G A T T T
                           ... 1110                1120                1130                1140

VAL  ASN  ALA  TYR  ASP  THR  VAL  ASP  PHE...
T G T C A A T G C T T A C G A C A C A G T A G A T T T ...
          1150                1160                ...
                           ...  VAL  ASN  GLY  THR  ASN  THR  ASN  VAL  ASN  VAL  THR
                           ...T G T C A A T G G T A C A A A C A C C A A T G T G A A C G T T A C
                           ... 1170                1180                1190                1200

THR  ASP  THR  ALA  HIS  LYS  LYS  THR  THR...
G A C T G A T A C G G C T C A C A A A A A G A C A A C ...
          1210                1220                ...
```

FIG.23G

```
...    VAL  ARG  VAL  ASP  VAL  THR  GLY  LEU  PRO  VAL  GLN
...C G T C C G T G T G G A T G T A A C A G G C T T G C C G G T T C A
...  1230      1240      1250      1260

  TYR  VAL  THR  GLU  ASP  GLY  LYS  THR  VAL...
A T A T G T T A C G G A A G A C G G C A A A A C C G T ...
          1270      1280      ...

...    VAL  LYS  VAL  ASP  ASN  LYS  TYR  TYR  GLU  ALA  LYS
...T G T G A A A A G T G G A C A A T A A G T A T T A C G A A G C T A A
...  1290      1300      1310      1320

  GLN  ASP  GLY  SER  ALA  ASP  MET  ASP  LYS...
G C A A G A C G G G T T C G G C G G A T A T G G A T A A ...
          1330      1340      ...

...    LYS  VAL  GLU  ASN  GLY  GLU  LEU  ALA  LYS  THR  LYS
...A A A A G T C G A A A A A T G G C G A G C T G G C G A A A A A C C A A
...  1350      1360      1370      1380

  VAL  LYS  LEU  VAL  SER  ALA  SER  GLY  GLN...
A G T G A A A T T G G T G T C G G C A A G C G G T C A ...
          1390      1400      ...

...    ASN  PRO  VAL  LYS  ILE  SER  ASN  VAL  ALA  GLU  GLY
...A A A T C C G G T G A A A A A T C A G C A A T G T T G C G G A A G G
...  1410      1420      1430      1440
```

FIG.23H

```
   THR  GLU  GLU  ASN  ASP  ALA  VAL  SER  PHE...
C A C G G A A G A A A A C G A T G C G G T C A G C T T ...
            1450              1460              ...
                                    ...  LYS  GLN  LEU  LYS  ALA  LEU  GLN  GLU  LYS  GLN  VAL
                                    ...T A A G C A A T T G A A A G C C T T G C A A G A G A A A C A G G T
                                    ... 1470              1480              1490              1500

   THR  LEU  THR  ALA  SER  ASN  ALA  TYR  ALA...
T A C T T T A A C T G C G A G C A A T G C T T A T G C ...
            1510              1520              ...
                                    ...  ASN  GLY  GLY  ASN  ASP  ALA  ASP  GLY  GLY  LYS  ALA
                                    ...C A A T G G T G G T A A C G A T G C C G A C G G C G G C A A G G C
                                    ... 1530              1540              1550              1560

   THR  GLN  THR  LEU  ASN  ASN  GLY  LEU  ASN...
A A C T C A A A C T T T A A A C A A T G G T T T G A A ...
            1570              1580              ...
                                    ...  PHE  LYS  PHE  LYS  SER  THR  ASP  GLY  GLU  LEU  LEU
                                    ...T T T T A A A T T T A A A T C C A C A G A C G G C G A G T T G T T
                                    ... 1590              1600              1610              1620

   ASN  ILE  LYS  VAL  GLU  ASN  ASP  THR  VAL...
G A A C A T C A A A G T A G A A A A T G A C A C A G T ...
            1630              1640              ...
```

FIG.23I

```
                                    ...  THR  PHE  THR  PRO  LYS  LYS  GLY  SER  VAL  GLN  VAL
                                   ...T A C C T T T A C G C C G A A A A A A G G T T C G G T A C A G G T
                                   ... 1650              1660              1670              1680

  GLY  GLU  ASP  GLY  LYS  ALA  THR  ILE  GLN...
T G G C G A A G A C G G T A A G G C T A C G A T T C A ...
          1690              1700              ...
                                   ...  ASN  GLY  THR  LYS  THR  THR  ASP  GLY  LEU  VAL  GLU
                                   ...A A A T G G T A C G A A A A C A A C C G A C G G T T T G G T T G A
                                   ... 1710              1720              1730              1740

  ALA  SER  GLU  LEU  VAL  GLU  SER  LEU  ASN...
A G C T T C C G A A T T G G T T G A A A G C C T G A A ...
          1750              1760              ...
                                   ...  LYS  LEU  GLY  TRP  LYS  VAL  GLY  VAL  ASP  LYS  ASP
                                   ...C A A A C T G G G C T G G A A A G T G G G C G T T G A T A A A G A
                                   ... 1770              1780              1790              1800

  GLY  SER  GLY  GLU  LEU  ASP  GLY  ALA  SER...
C G G C A G C G G C G A G C T T G A T G G T G C A T C ...
          1810              1820              ...
                                   ...  ASN  GLU  THR  LEU  VAL  LYS  SER  GLY  ASP  LYS  VAL
                                   ...C A A T G A A A C T T T A G T G A A G T C G G G C G A T A A A G T
                                   ... 1830              1840              1850              1860
```

FIG.23J

```
   THR   LEU   LYS   ALA   GLY   GLU   ASN   LEU   LYS...
A A C T T T G A A A G C C G G C G A G A A T C T G A A ...
              1870                1880                ...
                                  ...   VAL   LYS   GLN   ASP   GLY   THR   ASN   PHE   THR   TYR   ALA
                                  ...G G T C A A A C A A G A C G G C A C A A A C T T C A C T T A C G C
                                  ... 1890                1900                1910                1920

   LEU   LYS   ASP   GLU   LEU   THR   GLY   VAL   LYS...
G C T C A A A G A T G A A T T G A C G G G C G T G A A ...
              1930                1940                ...
                                  ...   SER   VAL   GLU   PHE   LYS   ASP   THR   ALA   ASN   GLY   SER
                                  ...G A G C G T G G A G T T T A A A G A C A C G G C G A A T G G T T C
                                  ... 1950                1960                1970                1980

   ASN   GLY   ALA   SER   THR   LYS   ILE   THR   LYS...
A A A C G G T G C A A G C A C G A A G A T T A C C A A ...
              1990                2000                ...
                                  ...   ASP   GLY   LEU   THR   ILE   THR   SER   ALA   ASN   GLY   ALA
                                  ...A G A C G G C T T G A C C A T T A C G T C G G C A A A C G G T G C
                                  ... 2010                2020                2030                2040

   ASN   GLY   ALA   ALA   ALA   THR   ASP   ALA   ASP...
G A A T G G T G C G G C G G C G A C T G A T G C G G A ...
              2050                2060                ...
```

FIG.23K

```
... LYS ILE LYS VAL ALA SER ASP GLY ILE SER ALA
...C A A G A T T A A A G T G G C T T C A G A C G G C A T C A G T G C
... 2070          2080          2090          2100

GLY ASN LYS ALA VAL LYS ASN VAL VAL...
G G G T A A T A A A G C G G T T A A A A A C G T T G T ...
        2110          2120                ...

... SER GLY LEU LYS LYS PHE GLY ASP ALA ASN PHE
...G A G C G G A C T G A A G A A A T T T G G T G A T G C G A A T T T
... 2130          2140          2150          2160

ASN PRO LEU THR SER SER ALA ASP ASN...
C A A T C C A C T G A C C A G T T C C G C C G A C A A ...
        2170          2180                ...

... LEU THR LYS GLN TYR ASP ASP ALA TYR LYS GLY
...C T T A A C G A A A C A A T A T G A C G A T G C C T A T A A A G G
... 2190          2200          2210          2220

LEU THR ASN LEU ASP GLU LYS GLY ALA...
C T T G A C C A A T T T G G A T G A A A A A G G T G C ...
        2230          2240                ...

... ASP LYS GLN THR LEU THR VAL ALA ASP ASN THR
...G G A C A A G C A A A C T C T G A C T G T T G C C G A C A A T A C
... 2250          2260          2270          2280
```

FIG.23L

```
   ALA   ALA   THR   VAL   GLY   ASP   LEU   ARG   GLY...
 T G C C G C A A C C G T G G G C G A T T T G C G C G G ...
             2290                2300                ...
                                    ...  LEU   GLY   TRP   VAL   ILE   SER   ALA   ASP   LYS   THR   THR
                                    ...C T T G G G C T G G G T C A T T T C T G C G G A C A A A A C C A C
                                    ... 2310                2320                2330                2340

   GLY   GLU   LEU   ASN   LYS   GLU   TYR   ASN   ALA...
 A G G C G A A C T C A A T A A G G A A T A C A A C G C ...
             2350                2360                ...
                                    ...  GLN   VAL   ARG   ASN   ALA   ASN   GLU   VAL   LYS   PHE   LYS
                                    ...G C A A G T G C G T A A C G C C A A T G A A G T G A A A T T C A A
                                    ... 2370                2380                2390                2400

   SER   GLY   ASN   GLY   ILE   HIS   VAL   SER   GLY...
 G A G C G G C A A C G G T A T C C A T G T T T C C G G ...
             2410                2420                ...
                                    ...  LYS   THR   VAL   ASN   GLY   ARG   ARG   GLU   ILE   THR   PHE
                                    ...T A A A A C G G T C A A C G G T A G G C G C G A A A T T A C T T T
                                    ... 2430                2440                2450                2460

   GLU   LEU   ALA   LYS   ASP   GLU   ASN   ALA   ILE...
 T G A A T T G G C T A A A G A C G A A A A T G C C A T ...
             2470                2480                ...
```

FIG.23M

```
...  ALA  PHE  GLY  TYR  GLY  SER  LYS  ALA  LEU  ARG  ASP
...T G C T T T C G G G T T A T G G C T C A A A A G C C T T G C G C G A
... 2490                2500                2510                2520

  ASN  THR  VAL  ALA  ILE  GLY  THR  GLY  ASN...
T A A C A C G G T G G C A A T T G G T A C G G G C A A ...
                2530                 ...
...  VAL  VAL  ASN  ALA  GLU  LYS  SER  GLY  ALA  PHE  GLY
...C G T T G T G A A T G C G G A A A A A T C T G G T G C A T T C G G
... 2550                2560                2570                2580

  ASP  PRO  ASN  TYR  ILE  GLU  ASP  LYS  ALA...
C G A T C C G A A C T A C A T C G A A G A T A A A G C ...
                2590                 2600                 ...
...  GLY  GLY  SER  TYR  ALA  PHE  GLY  ASN  ASP  ASN  ARG
...C G G T G G C A G C T A C G C T T T C G G T A A C G A T A A C C G
... 2610                2620                2630                2640

  ILE  THR  SER  LYS  ASN  THR  PHE  VAL  LEU...
T A T T A C T T C T A A A A A C A C T T T T G T G T T ...
                2650                 2660                 ...
...  GLY  ASN  GLY  VAL  ASN  ALA  LYS  TYR  LYS  ALA  ASN
...G G G T A A T G G A G T T A A T G C G A A A T A T A A A G C C A A
... 2670                2680                2690                2700
```

FIG.23N

```
 GLY  ASP  VAL  ASP  THR  GLU  THR  VAL  THR...
T G G A G A T G T T G A T A C G G A A A C C G T A A C ...
          2710                    2720                 ...
                                  ...  VAL  LYS  ASP  LYS  ASP  GLY  LYS  GLU  THR  THR  VAL
                                  ...C G T T A A G G A C A A A G A C G G T A A A G A G A C T A C C G T
                                  ... 2730                2740                2750               2760

 THR  VAL  PRO  LYS  ALA  LEU  GLY  ALA  THR...
T A C T G T T C C T A A A G C G T T A G G G G C T A C ...
          2770                    2780                 ...
                                  ...  VAL  GLU  ASN  SER  VAL  TYR  LEU  GLY  ASN  LYS  SER
                                  ...G G T T G A A A A C T C C G T T T A T T T G G G T A A T A A A T C
                                  ... 2790                2800                2810               2820

 THR  ALA  THR  LYS  ASP  LYS  GLY  LYS  ASN...
G A C T G C G A C A A A A G A T A A G G G T A A A A A ...
          2830                    2840                 ...
                                  ...  LEU  LYS  SER  ASP  GLY  THR  ALA  GLY  ASN  THR  THR
                                  ...C C T G A A A T C T G A T G G T A C G G C G G G T A A C A C T A C
                                  ... 2850                2860                2870               2880

 THR  ALA  GLY  THR  THR  GLY  THR  VAL  ASN...
A A C T G C T G G C A C A A C G G G T A C G G T A A A ...
          2890                    2900                 ...
```

FIG.23O

```
...   GLY  PHE  ALA  GLY  ALA  THR  ALA  HIS  GLY  ALA  VAL
...C G G C T T T G C C G G T G C A A C G G C G C A C G G T G C G G T
...  2910                 2920                 2930                 2940

   SER  VAL  GLY  ALA  SER  GLY  GLU  GLU  ARG...
T T C T G T C G G C G C A A G C G G C G A A G A A A G ...
                2950                 2960                 ...

...   ARG  ILE  GLN  ASN  VAL  ALA  ALA  GLY  GLU  ILE  SER
...A C G T A T C C A A A A C G T C G C G G C A G G C G A A A T T T C
...  2970                 2980                 2990                 3000

   ALA  THR  SER  THR  ASP  ALA  ILE  ASN  GLY...
C G C C A C T T C C C A C C G A T G C G A T T A A C G G ...
                3010                 3020                 ...

...   SER  GLN  LEU  TYR  ALA  VAL  ALA  LYS  GLY  VAL  THR
...C A G C C A G T T G T A T G C T G T G G C A A A A G G G G T A A C
...  3030                 3040                 3050                 3060

   ASN  LEU  ALA  GLY  GLN  VAL  ASN  LYS  VAL...
A A A T C T T G C T G G A C A A G T G A A T A A A G T ...
                3070                 3080                 ...

...   GLY  LYS  ARG  ALA  ASP  ALA  GLY  THR  ALA  SER  ALA
...G G G C A A A C G T G C A G A T G C A G G T A C A G C A A G T G C
...  3090                 3100                 3110                 3120
```

FIG.23P

```
   LEU  ALA  ALA  SER  GLN  LEU  PRO  GLN  ALA...
A T T A G C A G C T T C A C A G T T A C C A C A A G C ...
         3130                 ...
                              3140
   ...    SER  MET  PRO  GLY  LYS  SER  MET  VAL  SER  ILE  ALA
   ...C T C T A T G C C A G G T A A A T C A A T G G T T T C T A T T G C
   ... 3150                 3160                 3170                 3180

   GLY  SER  SER  TYR  GLN  GLY  GLN  ASN  GLY...
G G G A A G T A G T T A T C A A G G T C A A A A A T G G ...
         3190                 3200                 ...
                              ...    LEU  ALA  ILE  GLY  VAL  SER  ARG  ILE  SER  ASP  ASN
                              ...T T T A G C T A T C G G G G T A T C A C G A A T T T C C G A T A A
                              ... 3210                 3220                 3230                 3240

   GLY  LYS  VAL  ILE  ILE  ARG  LEU  SER  GLY...
T G G C A A A G T G A T T A T T C G C T T G T C A G G ...
         3250                 3260                 ...
                              ...    THR  THR  ASN  SER  GLN  GLY  LYS  THR  GLY  VAL  ALA
                              ...C A C A A C C A A T A G C C A A G G T A A A A C A G G C G T T G C
                              ... 3270                 3280                 3290                 3300

   ALA  GLY  VAL  GLY  TYR  GLN  TRP  ***
A G C A G G T G T T G G T T A C C A G T G G T A A T A ...
         3310                 3320                 ...
                              ...G A A T T G A T C C G C
                              ... 3330
```

FIG.24A

H. influenzae type c strain API *hia* sequence

```
 MET  ASN  LYS  ILE  PHE  ASN  VAL  ILE  TRP  ASN ...
A T G A A C A A A A T T T T T A A C G T T A T T T G G A A T...
              10                   20                   30...
                                  ... VAL  MET  THR  GLN  THR  TRP  VAL  VAL  VAL  SER
                                  ... G T T A T G A C T C A A A C T T G G G T T G T C G T A T C T
                                  ...                  40                   50                   60

 GLU  LEU  THR  ARG  THR  HIS  THR  LYS  ARG  ALA ...
G A A C T C A C T C G C A C C C A C A C C A A A C G C G C C...
              70                   80                   90...
                                  ... SER  ALA  THR  VAL  GLU  THR  ALA  VAL  LEU  ALA
                                  ... T C C G C A A C C G T G G A G A C C G C C G T A T T G G C G
                                  ...                 100                  110                  120

 THR  LEU  LEU  PHE  ALA  THR  VAL  GLN  ALA  ASN ...
A C A C T G T T G T T T G C A A C G G T T C A G G C G A A T...
              130                  140                  150...
                                  ... ALA  THR  ASP  GLU  ASP  GLU  GLU  LEU  ASP  PRO
                                  ... G C T A C C G A T G A A G A T G A A G A G T T A G A C C C C
                                  ...                 160                  170                  180

 VAL  VAL  ARG  THR  ALA  PRO  VAL  LEU  SER  PHE ...
G T A G T A C G C A C T G C T C C C G T G T T G A G C T T C...
              190                  200                  210...
```

FIG.24B

```
... HIS SER ASP LYS GLU GLY THR GLY GLU LYS
... C A T T C C G A T A A A G A A G G C A C G G G A G A A A A A
                220                 230                 240
...                 ...

GLU VAL THR GLU ASN SER ASN TRP GLY ILE ...
G A A G T T A C A G A A A A T T C A A A T T G G G G A A T A...
            250                 260                 270....

... TYR PHE HIS ASN LYS GLY VAL LEU LYS ALA
... T A T T T C C A C A A T A A A G G A G T A C T A A A A G C C
                280                 290                 300
...                 ...

GLY ALA ILE THR LEU LYS ALA GLY ASP ASN ...
G G A G C A A T C A C C C T C A A A G C C G G C G A C A A C...
            310                 320                 330...

... LEU LYS ILE LYS GLN SER THR ASN ALA SER
... C T G A A A A T C A A A A C A A A G C A C C A A T G C C A G T
                340                 350                 360
...                 ...

SER PHE THR TYR SER LEU LYS LYS ASP LEU ...
A G C T T C A C C T A C T C G C T G A A A A A A G A C C T C...
            370                 380                 390...

... THR ASP LEU THR SER VAL ALA THR GLU LYS
... A C A G A T C T G A C C A G T G T T G C A A C T G A A A A A
                400                 410                 420
...                 ...
```

FIG.24C

```
 LEU  SER  PHE  GLY  ALA  ASN  GLY  ASP  LYS  VAL ...
T T A T C G T T T G G C G C A A A C G G C G A T A A A G T T...
                430                 440                 450...

...  ASP  ILE  THR  SER  ASP  ALA  ASN  GLY  LEU  LYS
... G A T A T T A C C C A G T G A T G C A A A T G G C T T G A A A
                460                 470                 480
...

 LEU  ALA  LYS  THR  GLY  ASN  GLY  ASN  VAL  HIS ...
T T G G C G A A A A C A G G T A A C G G A A A T G T T C A T...
                490                 500                 510...

...  LEU  ASN  GLY  LEU  ASP  SER  THR  LEU  PRO  ASP
... T T G A A T G G T T T G G A T T C A A C T T T G C C T G A T
                520                 530                 540
...

 ALA  VAL  THR  ASN  THR  GLY  VAL  LEU  SER  SER ...
G C G G T A A C G A A A T A C A G G T G T T A A G T T C A...
                550                 560                 570...

...  SER  SER  PHE  THR  PRO  ASN  ASP  VAL  GLU  LYS
... T C A A G T T T T A C A C C T A A T G A T G T T G A A A A A A
                580                 590                 600
...

 THR  ARG  ALA  ALA  THR  VAL  LYS  ASP  VAL  LEU ...
A C A A G A G C T G C A A C T G T T A A A G A T G T T T T A...
                610                 620                 630...
```

FIG.24D

```
                                    ... ASN  ALA  GLY  TRP  ASN  ILE  LYS  GLY  ALA  LYS
                                    ... A A T G C A G G T T G G A A C A T T A A A G G T G C T A A A
                                    ...                640                650                660

 THR  ALA  GLY  GLY  ASN  VAL  GLU  SER  VAL  ASP ...
A C T G C T G G A G G T A A T G T T G A G A G T G T T G A T...
               670                680                690...
                                    ... LEU  VAL  SER  ALA  TYR  ASN  ASN  VAL  GLU  PHE
                                    ... T T A G T G T C C G C T T A T A A T A A T G T T G A A T T T
                                    ...                700                710                720

 ILE  THR  GLY  ASP  LYS  ASN  THR  LEU  ASP  VAL ...
A T T A C A G G C G A T A A A A A C A C G C T T G A T G T T...
               730                740                750...
                                    ... VAL  LEU  THR  ALA  LYS  GLU  ASN  GLY  LYS  THR
                                    ... G T A T T A A C A G C T A A A G A A A A C G G T A A A A C A
                                    ...                760                770                780

 THR  GLU  VAL  LYS  PHE  THR  PRO  LYS  THR  SER ...
A C C G A A G T G A A A T T C A C A C C G A A A A C C T C T...
               790                800                810...
                                    ... VAL  ILE  LYS  GLU  LYS  ASP  GLY  LYS  LEU  PHE
                                    ... G T T A T C A A A G A A A A A G A C G G T A A G T T A T T T
                                    ...                820                830                840
```

FIG.24E

```
THR GLY LYS GLU ASN ASN ASP THR ASN LYS ...
A C T G G A A A A G A G A A T A A C G A C A C A A A T A A A...
          850                 860                870...
                              ... VAL THR SER ASN THR ALA THR ASP ASN THR
                              ... G T T A C A A G T A A C A C G G C G A C T G A T A A T A C A
                              ...          880                 890                 900

ASP GLU GLY ASN GLY LEU VAL THR ALA LYS ...
G A T G A G G G T A A T G G C T T A G T C A C T G C A A A A...
          910                 920                930...
                              ... ALA VAL ILE ASP ALA VAL ASN LYS ALA GLY
                              ... G C T G T G A T T G A T G C T G T G A A C A A G G C T G G T
                              ...          940                 950                 960

TRP ARG VAL LYS THR THR THR ALA ASN GLY ...
T G G A G A G T T A A A A C A A C T A C T G C T A A T G G T...
          970                 980                990...
                              ... GLN ASN GLY ASP PHE ALA THR VAL ALA SER
                              ... C A A A A T G G C G A C T T C G C A A C T G T T G C G T C A
                              ...          1000                1010                1020

GLY THR ASN VAL THR PHE GLU SER GLY ASP ...
G G C A C A A A T G T A A C C T T T G A A A G T G G C G A T...
          1030                1040               1050...
```

FIG.24F

```
... GLY THR THR ALA SER VAL THR LYS ASP THR
... G G T A C A A C A G C G T C A G T A A C T A A A G A T A C T
...           1060                1070                1080

ASN GLY ASN GLY ILE THR VAL LYS TYR ASP ...
A A C G G C A A T G G C A T C A C T G T T A A G T A C G A C...
      1090                1100                1110...
... ALA LYS VAL GLY ASP GLY LEU LYS PHE ASP
... G C G A A A G T T G G C G A C G G C T T G A A A T T T G A T
...           1120                1130                1140

SER ASP LYS LYS ILE VAL ALA ASP THR THR ...
A G C G A T A A A A A A A T C G T T G C A G A T A C G A C C...
      1150                1160                1170...
... ALA LEU THR VAL THR GLY GLY LYS VAL ALA
... G C A C T T A C T G T G A C A G G T G G T A A G G T A G C T
...           1180                1190                1200

GLU ILE ALA LYS GLU ASP ASP LYS LYS LYS ...
G A A A T T G C T A A A G A A G A T G A C A A G A A A A A A...
      1210                1220                1230...
... LEU VAL ASN ALA GLY ASP LEU VAL THR ALA
... C T T G T T A A T G C A G G C G A T T T G G T A A C A G C T
...           1240                1250                1260
```

FIG.24G

```
LEU GLY ASN LEU SER TRP LYS ALA LYS ALA ...
T T A G G T A A T C T A A G T T G G A A A G C A A A A G C T...
          1270          1280          1290...
... GLU ALA ASP THR ASP THR ASP GLY ALA LEU
... G A G G C T G A T A C T G A T A C T G A T G G T G C G C T T
...          1300          1310          1320

GLU GLY ILE SER LYS ASP GLN GLU VAL LYS ...
G A G G G G A T T T C A A A A G A C C A A G A A G T C A A A...
          1330          1340          1350...
... ALA GLY GLU THR VAL THR PHE LYS ALA GLY
... G C A G G C G A A A C G G T A A C C T T T A A A G C G G G C
...          1360          1370          1380

LYS ASN LEU LYS VAL LYS GLN ASP GLY ALA ...
A A G A A C T T A A A A G T G A A A C A G G A T G G T G C G...
          1390          1400          1410...
... ASN PHE THR TYR SER LEU GLN ASP ALA LEU
... A A C T T T A C T T A T T C A C T G C A A G A T G C T T T A
...          1420          1430          1440

THR GLY LEU THR SER ILE THR LEU GLY GLY ...
A C G G G T T T A A C G A G C A T T A C T T T A G G T G G T...
          1450          1460          1470...
```

FIG.24H

```
                                        ... THR  THR  ASN  GLY  GLY  ASN  ASP  ALA  LYS  THR
                                        ... A C A A C T A A T G G C G G A A A T G A T G C G A A A A C C
                                        ...           1480                1490                1500
VAL  ILE  ASN  LYS  ASP  GLY  LEU  THR  ILE  THR ...
G T C A T C A A C A A A G A C G G T T T A A C C A T C A C G...
          1510                1520                1530...
                                        ... PRO  ALA  GLY  ASN  GLY  GLY  THR  THR  GLY  THR
                                        ... C C A G C A G G T A A T G G C G G T A C G A C A G G T A C A
                                        ...           1540                1550                1560
ASN  THR  ILE  SER  VAL  THR  LYS  ASP  GLY  ILE ...
A A C A C C A T C A G C G T A A C C A A A G A T G G C A T T...
          1570                1580                1590...
                                        ... LYS  ALA  GLY  ASN  LYS  ALA  ILE  THR  ASN  VAL
                                        ... A A A G C A G G T A A T A A A G C T A T T A C T A A T G T T
                                        ...           1600                1610                1620
ALA  SER  GLY  LEU  ARG  ALA  TYR  ASP  ASP  ALA ...
G C G A G T G G T T T A A G A G C T T A T G A C G A T G C G...
          1630                1640                1650...
                                        ... ASN  PHE  ASP  VAL  LEU  ASN  ASN  SER  ALA  THR
                                        ... A A T T T T G A T G T T T T A A A T A A C T C T G C A A C T
                                        ...           1660                1670                1680
```

FIG.24I

```
  ASP  LEU  ASN  ARG  HIS  VAL  GLU  ASP  ALA  TYR ...
G A T T T A A A T A G A C A C G T T G A A G A T G C T T A T...
                1690                1700                1710...

  ...  LYS  GLY  LEU  LEU  ASN  LEU  ASN  GLU  LYS  ASN
  ... A A A G G T T T A T T A A A T C T A A A T G A A A A A A T
                1720                1730                1740
  ...

  ALA  ASN  LYS  GLN  PRO  LEU  VAL  THR  ASP  SER ...
G C A A A T A A A C A A C C G T T G G T G A C T G A C A G C...
                1750                1760                1770...

  ...  THR  ALA  ALA  THR  VAL  GLY  ASP  LEU  ARG  LYS
  ... A C G G C G G C G A C T G T A G G C G A T T T A C G T A A A
                1780                1790                1800
  ...

  LEU  GLY  TRP  VAL  VAL  SER  THR  LYS  ASN  GLY ...
T T G G G T T G G G T A G T A T C A A C C A A A A A C G G T...
                1810                1820                1830...

  ...  THR  LYS  GLU  GLU  SER  ASN  GLN  VAL  LYS  GLN
  ... A C G A A A G A A G A A A G C A A T C A A G T T A A A C A A
                1840                1850                1860
  ...

  ALA  ASP  GLU  VAL  LEU  PHE  THR  GLY  ALA  GLY ...
G C T G A T G A A G T C C T C T T T A C C G G A G C C G G T...
                1870                1880                1890...
```

FIG.24J

```
... ALA ALA THR VAL THR SER LYS SER GLU ASN
... G C T G C T A C G G T T A C T T C C A A A T C T G A A A A C
...                1900      1910      1920

GLY LYS HIS THR ILE THR VAL SER VAL ALA ....
G G T A A A C A T A C G A T T A C C G T T A G T G T G G C T...
                1930      1940      1950....

... GLU THR LYS ALA ASP SER GLY LEU GLU LYS
... G A A A C T A A A A G C G G A T A G C G G T C T T G A A A A A
...                1960      1970      1980

ASP GLY ASP THR ILE LYS LEU LYS VAL ASP ...
G A T G G C G A T A C T T A A G C T C A A A G T G G A T...
                1990      2000      2010....

... ASN GLN ASN THR ASP ASN VAL LEU THR VAL
... A A T C A A A A A C A C T G A T A A T G T T T T A A C T G T T
...                2020      2030      2040

GLY ASN ASN GLY THR ALA VAL THR LYS GLY ...
G G T A A T T A A T G G T A C T G C T G T C A C T A A A G G T...
                2050      2060      2070....

... GLY PHE GLU THR VAL LYS THR GLY ALA THR
... G G C T T T G A A A A C T G T T A A A A C T G G A G C G A C T
...                2080      2090      2100
```

FIG.24K

```
ASP  ALA  ASP  ARG  GLY  LYS  VAL  THR  VAL  LYS ...
G A T G C A G A T C G C G G T A A A G T A A C T G T A A A A...
          2110                2120                2130...
                                ... ASP  ALA  THR  ALA  ASN  ASP  ALA  ASP  LYS  LYS
                                ... G A T G C T A C T G C T A A T G A C G C T G A T A A G A A A
                                ...           2140                2150                2160

VAL  ALA  THR  VAL  LYS  ASP  VAL  ALA  THR  ALA ...
G T C G C A A C T G T A A A A G A T G T T G C A A C C G C A...
          2170                2180                2190...
                                ... ILE  ASN  SER  ALA  ALA  THR  PHE  VAL  LYS  THR
                                ... A T T A A T A G T G C G G C G A C T T T T G T G A A A A C A
                                ...           2200                2210                2220

GLU  ASN  LEU  THR  THR  SER  ILE  ASP  GLU  ASP ...
G A G A A T T T A A C T A C C T C T A T T G A T G A A G A T...
          2230                2240                2250...
                                ... ASN  PRO  THR  ASP  ASN  GLY  LYS  ASP  ASP  ALA
                                ... A A T C C T A C A G A T A A C G G C A A A G A T G A C G C A
                                ...           2260                2270                2280

LEU  LYS  ALA  GLY  ASP  THR  LEU  THR  PHE  LYS ...
C T T A A A G C G G G C G A T A C C T T A A C C T T T A A A...
          2290                2300                2310...
```

FIG.24L

```
... ALA GLY LYS ASN LEU LYS VAL LYS ARG ASP
... G C A G G T A A A A A C C T G A A A G T T A A A C G T G A T
...                2320                2330                2340

GLY LYS ASN ILE THR PHE ASP LEU ALA LYS ...
G G A A A A A A T A C T T T G A C T T G G C G A A A...
                2350                2360....

... ASN LEU GLU VAL LYS THR ALA LYS VAL SER
... A A C C T T G A G G T G A A A A C T G C G A A A G T G A G T
...                2380                2390                2400

ASP THR LEU THR ILE GLY GLY ASN THR PRO ...
G A T A C T T T A A C G A T T G G C G G G A A T A C A C C T...
                2410                2420                2430...

... THR GLY GLY THR THR ALA THR PRO LYS VAL
.... A C A G G T G G C A C T A C T G C G A C G C C A A A A G T G
...                2440                2450                2460

ASN ILE THR SER THR ALA ASP GLY LEU ASN ....
A A T A T T A C T A G C A C G G C T G A T G G T T T G A A T...
                2470                2480....

... PHE ALA LYS GLU THR ALA ASP ALA SER GLY
... T T T G C A A A A G A A A C A G C C G A T G C C T C G G G T
...                2500                2510                2520
```

FIG.24M

```
SER  LYS  ASN  VAL  TYR  LEU  LYS  GLY  ILE  ALA ...
T C T A A G A A T G T T A T T G A A A G G T A T T G C G...
          2530                2540       2550...

...  THR  THR  LEU  THR  GLU  PRO  SER  ALA  GLY  ALA
... A C A A C T T T A A C T G A G C C A A G C G C G G A G C G
...                2560       2570                2580

LYS  SER  SER  HIS  VAL  ASP  LEU  ASN  VAL  ASP ...
A A G T C T T C A C A C G T T G A T T T A A A T G T G G A T...
          2590                2600       2610...

...  ALA  THR  LYS  LYS  SER  ASN  ALA  ALA  SER  ILE
... G C G A C G A A A A A A T C C A A T G C A G C A A G T A T T
...                2620       2630                2640

GLU  ASP  VAL  LEU  ARG  ALA  GLY  TRP  ASN  ILE ...
G A A G A T G T A T T G C G C G C A G G T T G G A A T A T T...
          2650                2660       2670...

...  GLN  GLY  ASN  GLY  ASN  ASN  VAL  ASP  TYR  VAL
... C A A G G T A A T G G T A A T A A T G T T G A T T A T G T A
...                2680       2690                2700

ALA  THR  TYR  ASP  THR  VAL  ASN  PHE  THR  ASP ...
G C G A C G T A T G A C A C A G T A A A C T T T A C C G A T...
          2710                2720       2730...
```

FIG.24N

```
                                        ... ASP  SER  THR  GLY  THR  THR  THR  VAL  THR  VAL
                                        ... G A C A G C A C A G G T A C A A C A A C G G T A A C C G T A
                                        ...              2740              2750              2760

 THR  GLN  LYS  ALA  ASP  GLY  LYS  GLY  ALA  ASP ...
A C C C A A A A A G C A G A T G G C A A A G G T G C T G A C...
            2770              2780              2790...
                                        ... VAL  LYS  ILE  GLY  ALA  LYS  THR  SER  VAL  ILE
                                        ... G T T A A A A T C G G T G C G A A A A C T T C T G T T A T C
                                        ...              2800              2810              2820

 LYS  ASP  HIS  ASN  GLY  LYS  LEU  PHE  THR  GLY ...
A A A G A C C A C A A C G G C A A A C T G T T T A C A G G C...
            2830              2840              2850...
                                        ... LYS  ASP  LEU  LYS  ASP  ALA  ASN  ASN  GLY  ALA
                                        ... A A A G A C C T G A A A G A T G C G A A T A A T G G T G C A
                                        ...              2860              2870              2880

 THR  VAL  SER  GLU  ASP  ASP  GLY  LYS  ASP  THR ...
A C C G T T A G T G A A G A T G A T G G C A A A G A C A C C...
            2890              2900              2910...
                                        ... GLY  THR  GLY  LEU  VAL  THR  ALA  LYS  THR  VAL
                                        ... G G C A C A G G C T T A G T T A C T G C A A A A A C T G T G
                                        ...              2920              2930              2940
```

FIG.24O

```
ILE ASP ALA VAL ASN LYS SER GLY TRP ARG ...
A T T G A T G C A G T A A A T A A A A G C G G T T G G A G G...
          2950                2960                2970...
                                   ... VAL THR GLY GLU GLY ALA THR ALA GLU THR
                                   ... G T A A C C G G T G A G G G C G C G A C T G C C G A A A C C
                                   ...          2980                2990                3000

GLY ALA THR ALA VAL ASN ALA GLY ASN ALA ...
G G T G C A A C C G C C G T G A A T G C G G G T A A C G C T...
          3010                3020                3030...
                                   ... GLU THR VAL THR SER GLY THR SER VAL ASN
                                   ... G A A A C C G T T A C A T C A G G C A C G A G C G T G A A C
                                   ...          3040                3050                3060

PHE LYS ASN GLY ASN ALA THR THR ALA THR ...
T T C A A A A A C G G C A A T G C G A C C A C A G C G A C C...
          3070                3080                3090...
                                   ... VAL SER LYS ASP ASN GLY ASN ILE ASN VAL
                                   ... G T A A G C A A A G A T A A T G G C A A C A T C A A T G T C
                                   ...          3100                3110                3120

LYS TYR ASP VAL ASN VAL GLY ASP GLY LEU ...
A A A T A C G A T G T A A A T G T T G G T G A C G G C T T G...
          3130                3140                3150...
```

FIG.24P

```
... LYS  ILE  GLY  ASP  ASP  LYS  LYS  LYS  ILE  VAL  ALA
... A A G A T T G G C G A T G A C A A A A A A A T C G T T G C A
...                3160                3170                3180

ASP  THR  THR  THR  LEU  THR  VAL  THR  GLY  GLY ...
G A C A C G A C C C A C A C T T A C T G T A A C A G G T G G T...
          3190                3200                3210...

...  LYS  VAL  SER  VAL  PRO  ALA  GLY  ALA  ASN  SER
... A A G G T G T C T G T T C C T G C T G G T G C T A A T A G T
...                3220                3230                3240

VAL  ASN  ASN  ASN  LYS  LYS  LEU  VAL  ASN  ALA ...
G T T A A T A A C A A T A A G A A A A C T T G T T A A T G C A...
          3250                3260                3270...

...  GLU  GLY  GLY  LEU  ALA  THR  ALA  LEU  ASN  ASN  LEU
... G A G G G G T T T A G C G A C T G C T T T A A A C A A C C T A
...                3280                3290                3300

SER  TRP  THR  ALA  LYS  ALA  ASP  LYS  TYR  ALA ...
A G C T G G A C G G C A A A A G C C G A T A A A T A T G C A...
          3310                3320                3330...

...  ASP  GLY  GLU  SER  GLU  GLY  GLU  THR  ASP  GLN
... G A T G G C G A G T C A G A G G G C G A A A C C G A C C A A
...                3340                3350                3360
```

FIG.24Q

```
GLU  VAL  LYS  ALA  GLY  ASP  LYS  VAL  THR  PHE ...
G A A G T C A A A G C A G G C G A C A A A G T A A C C T T T...
                3370                 3380                3390...

...  LYS  ALA  GLY  LYS  ASN  LEU  LYS  VAL  LYS  GLN
... A A A G C A G G C A A G A A C T T A A A A G T G A A A C A G
...              3400                3410                3420

SER  GLU  LYS  ASP  PHE  THR  TYR  SER  LEU  GLN ...
T C T G A A A A A G A C T T T A C T T A T T C A C T G C A A...
                3430                3440                3450...

...  ASP  THR  LEU  THR  GLY  LEU  THR  SER  ILE  THR
... G A C A C T T T A A C A G G C T T A A C G A G C A T T A C T
...              3460                3470                3480

LEU  GLY  GLY  THR  ALA  ASN  GLY  ARG  ASN  ASP ...
T T A G G T G G T A C A G C T A A T G G C A G A A A T G A T...
                3490                3500                3510...

...  THR  GLY  THR  VAL  ILE  ASN  LYS  ASP  GLY  LEU
... A C G G G A A C C G T C A T C A A C A A A G A C G G C T T A
...              3520                3530                3540

THR  ILE  THR  LEU  ALA  ASN  GLY  ALA  ALA  ALA ...
A C C A T C A C G C T G G C A A A T G G T G C T G C G G C A...
                3550                3560                3570...
```

FIG.24R

```
                                     ... GLY THR ASP ALA SER ASN GLY ASN THR ILE
                                     ... G G C A C A G A T G C G T C T A A C G G A A A C A C C A T C
                                     ...           3580                3590                3600

SER VAL THR LYS ASP GLY ILE SER ALA GLY ...
A G T G T A A C C A A A G A C G G C A T T A G T G C G G G T...
          3610                3620           3630...
                                     ... ASN LYS GLU ILE THR ASN VAL LYS SER ALA
                                     ... A A T A A A G A A A T T A C C A A T G T T A A G A G T G C T
                                     ...           3640                3650                3660

LEU LYS THR TYR LYS ASP THR GLN ASN THR ...
T T A A A A A C C T A T A A A G A T A C T C A A A A C A C T...
          3670                3680           3690...
                                     ... ALA GLY ALA THR GLN PRO ALA ALA ASN THR
                                     ... G C A G G T G C A A C T C A A C C T G C G G C T A A T A C A
                                     ...           3700                3710                3720

ALA GLU VAL ALA LYS GLN ASP LEU VAL ASP ...
G C T G A A G T A G C C A A A C A A G A C T T G G T T G A T...
          3730                3740           3750...
                                     ... LEU THR LYS PRO ALA THR GLY ALA ALA GLY
                                     ... T T A A C T A A A C C T G C G A C A G G T G C A G C T G G A
                                     ...           3760                3770                3780
```

FIG.24S

```
ASN  GLY  ALA  ASP  ALA  LYS  ALA  PRO  ASP  THR ...
A A T G G T G C A G A T G C A A A A G C T C C C G A T A C C...
                3790                 3800                 3810...

...  THR  ALA  ALA  THR  VAL  GLY  ASP  LEU  ARG  GLY
... A C A G C T G C A A C C G T A G G C G A C T T G C G T G G T
                3820                 3830                 3840
...

LEU  GLY  TRP  VAL  LEU  SER  ALA  LYS  LYS  THR ...
T T G G G C T G G G T G C T T T C A G C T A A G A A A A A C T...
                3850                 3860                 3870...

...  ALA  ASP  GLU  THR  GLN  ASP  LYS  GLU  PHE  HIS
... G C A G A T G A A A C A C A A G A T A A A G A G T T C C A C
                3880                 3890                 3900
...

ALA  ALA  VAL  LYS  ASN  ALA  ASN  GLU  VAL  GLU ....
G C C G C C G T T A A A A A C G C A A A T G A A G T T G A G...
                3910                 3920                 3930...

...  PHE  VAL  GLY  LYS  ASN  GLY  ALA  THR  VAL  SER
... T T C G T G G G T A A A A A C G G T G C A A C C G T G T C T
                3940                 3950                 3960
...

ALA  LYS  THR  ASP  ASN  ASN  GLY  LYS  HIS  THR ...
G C A A A A A C T G A T A A C A A C G G A A A A C A T A C T...
                3970                 3980                 3990...
```

FIG.24T

```
... VAL THR ILE ASP VAL ALA GLU ALA LYS VAL
... G T A A C G A T T G A T G T T G C A G A A G C C A A A G T T
          4000                4010                4020
...
GLY ASP GLY LEU GLU LYS ASP THR ASP GLY ...
G G T G A T G G T C T T G A A A A A G A T A C T G A C G G C...
          4030                4040                4050...
... LYS ILE LYS LEU LYS VAL ASP ASN THR ASP
... A A G A T T A A A C T C A A A G T A G A T A A T A C A G A T
          4060                4070                4080
...
GLY ASN ASN LEU LEU THR VAL ASP ALA THR ...
G G G A A T A A T C T A T T A A C C G T T G A T G C A A C A...
          4090                4100                4110...
... LYS GLY ALA SER VAL ALA LYS GLY GLU PHE
... A A A G G T G C A T C C G T T G C C A A G G G C G A G T T T
          4120                4130                4140
...
ASN ALA VAL THR THR ASP ALA THR THR ALA ...
A A T G C C G T A A C A A C A G A T G C A A C T A C A G C C...
          4150                4160                4170...
... GLN GLY THR ASN ALA ASN GLU ARG GLY LYS
... C A A G G C A C A A A T G C C A A T G A G C G C G G T A A A
          4180                4190                4200
...
```

FIG.24U

```
VAL  VAL  VAL  LYS  GLY  SER  ASN  GLY  ALA  THR ...
G T G G T T G T C A A G G G T T C A A A T G G T G C A A C T...
                4210                4220...

...  ALA  THR  GLU  THR  ASP  LYS  LYS  LYS  VAL  ALA
... G C T A C C G A A A C T G A C A A G A A A A A A G T G G C A
                4240                4250                4260

THR  VAL  GLY  ASP  VAL  ALA  LYS  ALA  ILE  ASN ....
A C T G T T G G C G A C G T T G C T A A A G C G A T T A A C...
                4270                4280

...  ASP  ALA  ALA  THR  PHE  VAL  LYS  VAL  GLU  ASN
... G A C G C A G C A A C T T T C G T G A A A G T G G A A A A T
                4290...             4300                4310                4320

ASP  ASP  SER  ALA  THR  ILE  ASP  ASP  SER  PRO ...
G A C G A C A G T G C T A C G A T T G A T G A T A G C C C A...
                4330                4340...

...  THR  ASP  ASP  GLY  ALA  ASN  ASP  ALA  LEU  LYS
... A C A G A T G A T G G C G C A A A T G A T G C T C T C A A A
                4350...             4360                4370                4380

ALA  GLY  ASP  THR  LEU  THR  LEU  LYS  ALA  GLY ...
G C A G G C G A C A C C T T G A C C T T A A A A G C G G G G T...
                4390                4400...
```

FIG.24V

```
                                    ... LYS  ASN  LEU  LYS  VAL  LYS  ARG  ASP  GLY  LYS
                                    ... A A A A A C T T A A A A G T T A A A C G T G A T G G T A A A
                                    ...            4420           4430           4440

 ASN  ILE  THR  PHE  ALA  LEU  ALA  ASN  ASP  LEU ...
A A T A T T A C T T T T G C C C T T G C G A A C G A C C T T...
          4450           4460           4470...
                                    ... SER  VAL  LYS  SER  ALA  THR  VAL  SER  ASP  LYS
                                    ... A G T G T A A A A A G C G C A A C C G T T A G C G A T A A A
                                    ...            4480           4490           4500

 LEU  SER  LEU  GLY  THR  ASN  GLY  ASN  LYS  VAL ...
T T A T C G C T T G G T A C A A A C G G C A A T A A A G T C...
          4510           4520           4530...
                                    ... ASN  ILE  THR  SER  ASP  THR  LYS  GLY  LEU  ASN
                                    ... A A T A T C A C A A G C G A C A C C A A A G G C T T G A A C
                                    ...            4540           4550           4560

 PHE  ALA  LYS  ASP  SER  LYS  THR  GLY  ASP  ASP ...
T T C G C T A A A G A T A G T A A G A C A G G C G A T G A T...
          4570           4580           4590...
                                    ... ALA  ASN  ILE  HIS  LEU  ASN  GLY  ILE  ALA  SER
                                    ... G C T A A T A T T C A C T T A A A T G G C A T T G C T T C A
                                    ...            4600           4610           4620
```

FIG.24W

```
THR LEU THR ASP THR LEU LEU ASN SER GLY ...
A C T T T A A C T G A T A C A T T G T T A A A T A G T G G T...
           4630                4640                4650...
                                     ... ALA THR THR ASN LEU GLY GLY ASN GLY ILE
                                     ... G C G A C A A C C A A T T T A G G T G G T A A T G G T A T T
                                     ...               4660                4670                4680

THR ASP ASN GLU LYS LYS ARG ALA ALA SER ...
A C T G A T A A C G A G A A A A A A C G C G C G G C G A G C...
           4690                4700                4710...
                                     ... VAL LYS ASP VAL LEU ASN ALA GLY TRP ASN
                                     ... G T T A A A G A T G T C T T G A A T G C G G G T T G G A A T
                                     ...               4720                4730                4740

VAL ARG GLY VAL LYS PRO ALA SER ALA ASN ...
G T T C G T G G T G T T A A A C C G G C A T C T G C A A A T...
           4750                4760                4770...
                                     ... ASN GLN VAL GLU ASN ILE ASP PHE VAL ALA
                                     ... A A T C A A G T G G A G A A T A T C G A C T T T G T A G C A
                                     ...               4780                4790                4800

THR TYR ASP THR VAL ASP PHE VAL SER GLY ...
A C C T A C G A C A C A G T G G A C T T T G T T A G T G G A...
           4810                4820                4830...
```

FIG.24X

```
... ASP LYS ASP THR THR SER VAL THR VAL GLU
... G A T A A A G A C A C C A C G A G T G T A A C T G T T G A A
                4840      4850      4860
...

SER LYS ASP ASN GLY LYS ARG THR GLU VAL ...
A G T A A A G A T A A T G G C A A G A A C C G A A G T T...
            4870      4880      4890...

... LYS ILE GLY ALA LYS THR SER VAL ILE LYS
... A A A A T C G G T G C G A A G A C T T C T G T T A T C A A A
                4900      4910      4920
...

ASP HIS ASN GLY LYS LEU PHE THR GLY LYS ...
G A C C A C A A C G G G C A A A C T G T T T A C A G G C A A A...
            4930      4940      4950...

... GLU LEU LYS ASP ALA ASN ASN ASN GLY VAL
... G A G C T G A A G G A T G C T A A C A A T A A T G G C G T A
                4960      4970      4980
...

THR VAL THR GLU THR ASP GLY LYS ASP GLU ...
A C T G T T A C C G A A A C C G A C G G C A A A G A C G A G...
            4990      5000      5010...

... GLY ASN GLY LEU VAL THR ALA LYS ALA VAL
... G G T A A T G G T T T A G T G A C T G C A A A A G C T G T G
                5020      5030      5040
...
```

FIG.24Y

```
ILE   ASP   ALA   VAL   ASN   LYS   ALA   GLY   TRP   ARG ...
A T T G A T G C C G T G A A T A A G G C T G G T T G G A G A...
            5050                5060                5070...
                                ...  VAL   LYS   THR   THR   GLY   ALA   ASN   GLY   GLN   ASN
                                ... G T T A A A A C A A C A G G T G C T A A T G G T C A G A A T
                                ...                5080                5090                5100

ASP   ASP   PHE   ALA   THR   VAL   ALA   SER   GLY   THR ...
G A T G A C T T C G C A A C T G T T G C G T C A G G C A C A...
            5110                5120                5130...
                                ...  ASN   VAL   THR   PHE   ALA   ASP   GLY   ASN   GLY   THR
                                ... A A T G T A A C C T T T G C T G A T G G T A A T G G C A C A
                                ...                5140                5150                5160

THR   ALA   GLU   VAL   THR   LYS   ALA   ASN   ASP   GLY ...
A C T G C C G A A G T A A C T A A A G C A A A C G A C G G T...
            5170                5180                5190...
                                ...  SER   ILE   THR   VAL   LYS   TYR   ASN   VAL   LYS   VAL
                                ... A G T A T T A C T G T T A A A T A C A A T G T T A A A G T G
                                ...                5200                5210                5220

ALA   ASP   GLY   LEU   LYS   LEU   ASP   GLY   ASP   LYS ...
G C T G A T G G C T T A A A A C T A G A C G G C G A T A A A...
            5230                5240                5250...
```

```
... ILE VAL ALA ASP THR THR VAL LEU THR VAL
... A T C G T T G C A G A C A C G A C C G T A C T T A C T G T G
...                 5260                    5270                    5280

ALA ASP GLY LYS VAL THR ALA PRO ASN ASN ...
G C A G A T G G T A A A G T T A C A G C T C C G A A T A A T...
                5290                    5300                    5310....

... GLY ASP GLY LYS LYS PHE VAL ASP ALA SER
... G G C G A T G G T A A G A A A T T T G T T G A T G C A A G T
...                 5320                    5330                    5340

GLY LEU ALA ASP ALA LEU ASN LYS LEU SER ...
G G T T T A G C C G G A T G C G T T A A A T A A A T T A A G C...
                5350                    5360                    5370...

... TRP THR ALA THR ALA GLY LYS GLU GLY THR
... T G G A C G G G C A A C T G C T G G T A A A G A A G G C A C T
...                 5380                    5390                    5400

GLY VAL ASP PRO ALA ASN SER ALA GLY ...
G G T G A A G T T G A T C C C T G C A A A T T C A G C A G G G...
                5410                    5420                    5430...

... GLN GLU VAL LYS ALA GLY ASP LYS VAL THR
... C A A G A A G T C A A A G C G G G C G A C A A A G T A A C C
...                 5440                    5450                    5460
```

FIG.24Z

FIG.24A'

```
 PHE  LYS  ALA  GLY  ASP  ASN  LEU  LYS  ILE  LYS ...
T T T A A A G C C G G C G A C A A C C T G A A A A T C A A A...
                5470                 5480                 5490...
 ...  GLN  SER  GLY  LYS  ASP  PHE  THR  TYR  SER  LEU
 ... C A A A G C G G G C A A A G A C T T T A C C T A C T C G C T G
                5500                 5510                 5520
 ...
 LYS  LYS  GLU  LEU  LYS  ASP  LEU  THR  SER  VAL ....
A A A A A A G A G C T G A A A G A C C T G A C C A G C G T A...
                5530                 5540                 5550...
 ...  GLU  PHE  LYS  ASP  ALA  ASN  GLY  GLY  THR  GLY
 ... G A G T T C A A A G A C G C A A A C G G G C G G T A C A G G C
                5560                 5570                 5580
 ...
 SER  GLU  SER  THR  LYS  ILE  THR  LYS  ASP  GLY ....
A G T G A A A A G C A C C A A G A T T A C C A A A G A C G G G C...
                5590                 5600                 5610...
 ...  LEU  THR  ILE  THR  PRO  ALA  ASN  GLY  ALA  GLY
 ... T T G A C C A T T A C G C C G G C A A A C G G T G C G G G T
                5620                 5630                 5640
 ...
 ALA  ALA  GLY  ALA  ASN  THR  ALA  ASN  THR  ILE ....
G C G G C A G G T G C A A A C A C T G C A A A C A C C A T T...
                5650                 5660                 5670...
```

FIG.24B'

```
... SER VAL THR LYS ASP GLY ILE SER ALA GLY
... A G C G T A A C C A A A G A T G G C A T T A G C G C G G G T
                5680                5690                5700
...                 ...

ASN LYS ALA VAL THR ASN VAL VAL SER GLY ...
A A T A A A G C A G T T A C A A A C G T T G T G A G C G G A...
                5710                5720                5730...
... LEU LYS LYS PHE GLY -ASP GLY HIS THR LEU
... C T G A A G A A A T T T G G T G A T G G T C A T A C G T T G
                5740                5750                5760
...                 ...

ALA ASN GLY THR VAL ALA ASP PHE GLU LYS ...
G C A A A T G G C A C T G T T G C T G A T T T T G A A A A G...
                5770                5780                5790...
... HIS TYR ASP ASN ALA TYR LYS ASP LEU THR
... C A T T A T G A C A A T G C C T A T A A A G A C T T G A C C
                5800                5810                5820
...                 ...

ASN LEU ASP GLU LYS GLY ALA ASP ASN ASN ...
A A T T T G G A T G A A A A A G G C G G A T A A T T A A T...
                5830                5840                5850...
... PRO THR VAL ALA ASP ASN THR ALA ALA THR
... C C G A C T G T T G C C G A C A A T A C C G C T G C A A C C
                5860                5870                5880
...                 ...
```

FIG.24C'

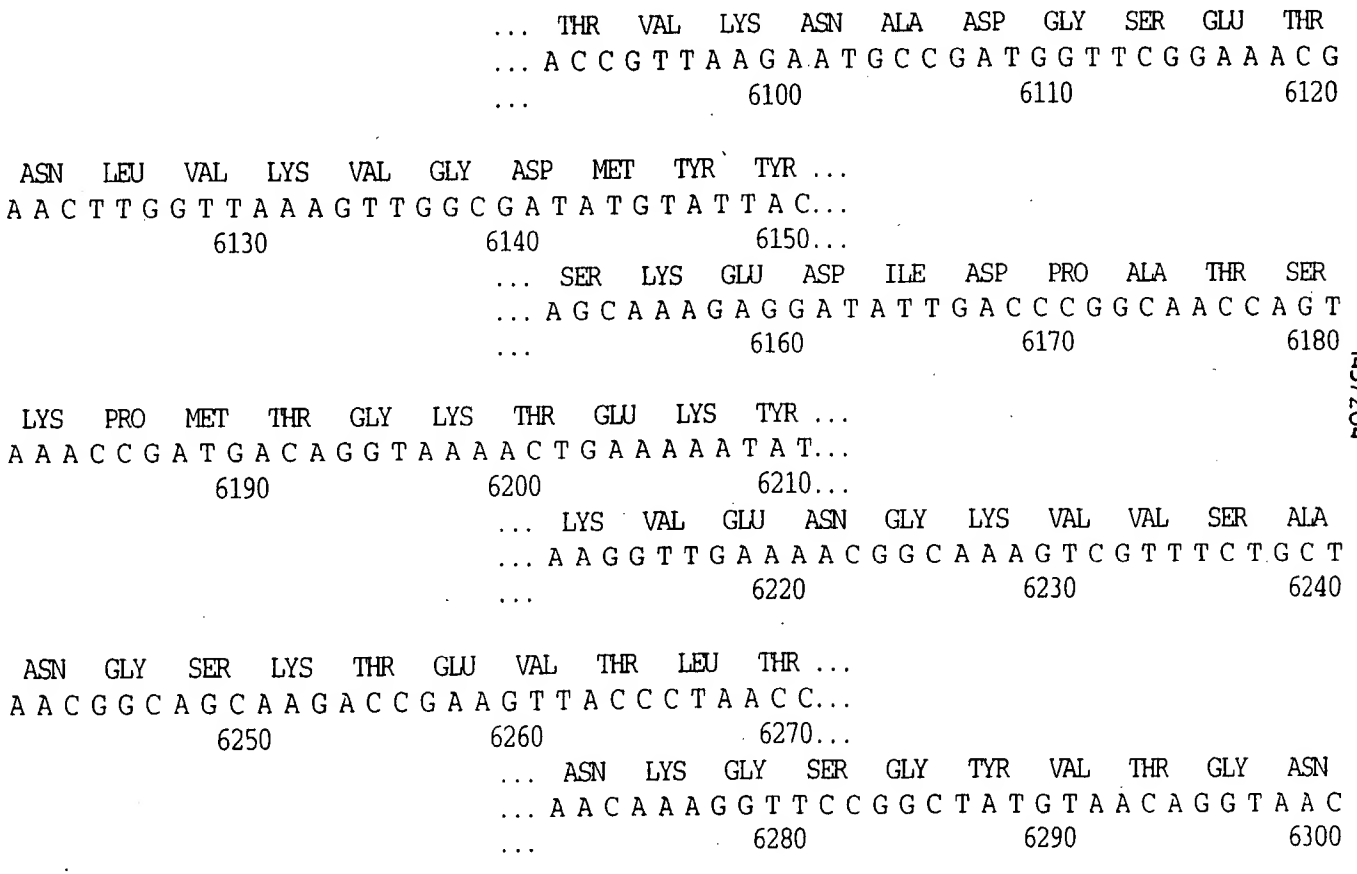
```
 VAL  GLY  ASP  LEU  ARG  GLY  LEU  GLY  TRP  VAL ...
G T G G G C G A T T T G C G C G G C T T G G G C T G G G T C...
            5890              5900              5910...
                                ... ILE  SER  ALA  ASP  LYS  THR  THR  GLY  GLU  PRO
                                ... A T T T C T G C G G A C A A A A C C A C A G G C G A A C C C
                                ...            5920              5930              5940

 ASN  GLN  GLU  TYR  ASN  ALA  GLN  VAL  ARG  ASN ...
A A T C A G G A A T A C A A C G C G C A A G T G C G T A A C...
            5950              5960              5970...
                                ... ALA  ASN  GLU  VAL  LYS  PHE  LYS  SER  GLY  ASN
                                ... G C C A A T G A A G T G A A A T T C A A G A G C G G C A A C
                                ...            5980              5990              6000

 GLY  ILE  ASN  VAL  SER  GLY  LYS  THR  LEU  ASN ...
G G T A T C A A T G T T T C C G G T A A A A C A T T G A A C...
            6010              6020              6030...
                                ... GLY  THR  ARG  VAL  ILE  THR  PHE  GLU  LEU  ALA
                                ... G G T A C G C G C G T G A T T A C C T T T G A A T T G G C T
                                ...            6040              6050              6060

 LYS  GLY  GLU  VAL  VAL  LYS  SER  ASN  GLU  PHE ...
A A A G G C G A A G T G G T T A A A T C G A A T G A A T T T...
            6070              6080              6090...
```

FIG.24D'



PCT/CA00/00289

FIG.24E'

```
GLN  VAL  ALA  ASP  ALA  ILE  ALA  LYS  SER  GLY ...
C A A G T G G C T G A T G C G A T T G C G A A A T C A G G C...
           6310                6320                6330...
                                ... PHE  GLU  LEU  GLY  LEU  ALA  ASP  ALA  ALA  GLU
                                ... T T T G A G C T T G G T T T G G C T G A T G C G G C A G A A
                                ...                6340                6350                6360

ALA  GLU  LYS  ALA  PHE  ALA  GLU  SER  ALA  LYS ...
G C T G A A A A A G C C T T T G C A G A A A G C G C A A A A...
           6370                6380                6390...
                                ... ASP  LYS  GLN  LEU  SER  LYS  ASP  LYS  ALA  GLU
                                ... G A C A A G C A A T T G T C T A A A G A T A A A G C G G A A
                                ...                6400                6410                6420

THR  VAL  ASN  ALA  HIS  ASP  LYS  VAL  ARG  PHE ...
A C T G T A A A T G C C C A C G A T A A A G T C C G T T T T...
           6430                6440                6450...
                                ... ALA  ASN  GLY  LEU  ASN  THR  LYS  VAL  SER  ALA
                                ... G C T A A T G G T T T A A A T A C C A A A G T G A G C G C G
                                ...                6460                6470                6480

ALA  THR  VAL  GLU  SER  THR  ASP  ALA  ASN  GLY ...
G C A A C G G T G G A A A G C A C T G A T G C A A A C G G C...
           6490                6500                6510...
```

FIG.24F'

```
                                      ... ASP  LYS  VAL  THR  THR  THR  PHE  VAL  LYS  THR
                                      ... G A T A A A G T G A C C A C A A C C T T T G T G A A A A C C
                                      ...            6520           6530           6540

ASP  VAL  GLU  LEU  PRO  LEU  THR  GLN  ILE  TYR ...
G A T G T G G A A T T G C C T T T A A C G C A A A T C T A C...
          6550           6560           6570...
                                      ... ASN  THR  ASP  ALA  ASN  GLY  ASN  LYS  ILE  VAL
                                      ... A A T A C C G A T G C A A A C G G T A A T A A G A T C G T T
                                      ...            6580           6590           6600

LYS  LYS  ALA  ASP  GLY  LYS  TRP  TYR  GLU  LEU ...
A A A A A A G C T G A C G G A A A A T G G T A T G A A C T G...
          6610           6620           6630...
                                      ... ASN  ALA  ASP  GLY  THR  ALA  SER  ASN  LYS  GLU
                                      ... A A T G C T G A T G G T A C G G C G A G T A A C A A A G A A
                                      ...            6640           6650           6660

VAL  THR  LEU  GLY  ASN  VAL  ASP  ALA  ASN  GLY ...
G T G A C A C T T G G T A A C G T G G A T G C A A A C G G T...
          6670           6680           6690...
                                      ... LYS  LYS  VAL  VAL  LYS  VAL  THR  GLU  ASN  GLY
                                      ... A A G A A A G T T G T G A A A G T A A C C G A A A A T G G T
                                      ...            6700           6710           6720
```

FIG.24G'

```
 ALA  ASP  LYS  TRP  TYR  TYR  THR  ASN  ALA  ASP ...
G C G G A T A A G T G G T A T T A C A C C A A T G C T G A C...
                6730                 6740                 6750...

 ...  GLY  ALA  ALA  ASP  LYS  THR  LYS  GLY  GLU  VAL
 ... G G T G C T G C G G A T A A A A C C A A A G G C G A A G T G
 ...                 6760                 6770                 6780

 SER  ASN  ASP  LYS  VAL  SER  THR  ASP  GLU  LYS ...
A G C A A T G A T A A A G T T C T A C C G A T G A A A A A...
                6790                 6800                 6810...

 ...  HIS  VAL  VAL  ARG  LEU  ASP  PRO  ASN  ASN  GLN
 ... C A C G T T G T C C G C C T T G A T C C G A A C A A T C A A
 ...                 6820                 6830                 6840

 SER  ASN  GLY  LYS  GLY  VAL  VAL  ILE  ASP  ASN ...
T C G A A C G G C A A A G G C G T G G T C A T T G A C A A T...
                6850                 6860                 6870...

 ...  VAL  ALA  ASN  GLY  GLU  ILE  SER  ALA  THR  SER
 ... G T G G C T A A T G G C G A A A T T T C T G C C A C T T C C
 ...                 6880                 6890                 6900

 THR  ASP  ALA  ILE  ASN  GLY  SER  GLN  LEU  TYR ...
A C C G A T G C G A T T A A C G G A A G T C A G T T G T A T...
                6910                 6920                 6930...
```

FIG.24H'

```
                                   ... ALA VAL ALA LYS GLY VAL THR ASN LEU ALA
                                   ... G C C G T G G C A A A A G G G G T A A C A A A C C T T G C T
                                   ...               6940                6950                6960

GLY GLN VAL ASN ASN LEU GLU GLY LYS VAL ...
G G A C A A G T G A A T A A T C T T G A G G G C A A A G T G...
             6970                6980                6990...
                                   ... ASN LYS VAL GLY LYS ARG ALA ASP ALA GLY
                                   ... A A T A A A G T G G G C A A A C G T G C A G A T G C A G G T
                                   ...               7000                7010                7020

THR ALA SER ALA LEU ALA ALA SER GLN LEU ...
A C A G C A A G T G C A T T A G C G G C T T C A C A G T T A...
             7030                7040                7050...
                                   ... PRO GLN ALA THR MET PRO GLY LYS SER MET
                                   ... C C A C A A G C C A C T A T G C C A G G T A A A T C A A T G
                                   ...               7060                7070                7080

VAL ALA ILE ALA GLY SER SER TYR GLN GLY ...
G T T G C T A T T G C G G G A A G T A G T T A T C A A G G T...
             7090                7100                7110...
                                   ... GLN ASN GLY LEU ALA ILE GLY VAL SER ARG
                                   ... C A A A A T G G T T T A G C T A T C G G G G T A T C A A G A
                                   ...               7120                7130                7140
```

FIG.24I'

```
ILE   SER   ASP   ASN   GLY   LYS   VAL   ILE   ILE   ARG ...
A T T T C C G A T A A T G G C A A A G T G A T T A T T C G C...
              7150                7160                7170...
                                    ... LEU   SER   GLY   THR   THR   ASN   SER   GLN   GLY   LYS
                                    ... T T G T C A G G C A C A A C C A A T A G T C A A G G T A A A
                                    ...                7180                7190                7200

THR   GLY   VAL   ALA   ALA   GLY   VAL   GLY   TYR   GLN ...
A C A G G C G T T G C A G C A G G T G T T G G T T A C C A G...
              7210                7220                7230...
                                    ... TRP   ***
                                    ... T G G T A A T A G A A T T C C G G A T C C G C
                                    ...                7240                7250
```

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FIG.25A

NTHi strain 12 *hia* locus

```
                TYR  TYR  HIS  TRP  ***  PRO  THR  PRO ...
G A A T T C T A T T A C C A C T G G T A A C C A A C A C C T ...
           10                  20                  30 ...
                                  ... ALA  ALA  THR  PRO  GLU  THR  ALA  GLN  GLN  ILE
                                  ...G C T G C A A C G C C A G A A A C A G C A C A A C A A A T T
                                  ...              40                  50                  60

 HIS  TRP  LEU  HIS  GLN  PHE  THR  LYS  ALA  ARG ...
C A C T G G C T A C A T C A A T T T A C C A A A G C T C G C ...
           70                  80                  90 ...
                                  ... ILE  GLN  TRP  ARG  LYS  THR  HIS  SER  LEU  PHE
                                  ...A T T C A A T G G C G C A A A A C C C A T T C C T T A T T C
                                  ...              100                 110                 120

 PHE  LYS  GLU  LYS  PRO  ASP  TYR  ALA  PHE  VAL ...
T T T A A A G A A A A A C C C G A T T A T G C C T T T G T G ...
           130                 140                 150 ...
                                  ... LEU  ALA  GLU  ASN  GLY  LYS  VAL  GLN  GLU  ILE
                                  ...C T G G C A G A A A A C G G C A A A G T G C A A G A A A T C
                                  ...              160                 170                 180

 LYS  ALA  GLU  TYR  ARG  ARG  ILE  ALA  ASN  GLN ...
A A A G C A G A A T A T C G C C G C A T T G C C A A T C A A ...
           190                 200                 210 ...
```

FIG.25B

```
... ILE  VAL  GLU  GLU  ALA  MET  ILE  ILE  ALA  ASN
...A T T G T G G A A G A A G C A A T G A T T A T T G C C A A C
    ...                 220                 230                 240

ILE  CYS  ALA  ALA  GLN  PHE  LEU  HIS  GLU  GLN ...
A T C T G C G C C G C C C A A T T T T A C A C G A A C A G ...
          250                 260                 270 ...

... ALA  LYS  THR  GLY  ILE  PHE  ASN  ALA  HIS  SER
...G C A A A A A C A G G C A T T T T C A A C G C C C A C A G C
    ...                 280                 290                 300

GLY  PHE  ASP  LYS  LYS  TYR  LEU  GLU  ASN  ALA ...
                                                 ...
G G T T T T G A T A A A A A A A T A C T T A G A A A A T G C G ...
          310                 320                 330 ...

... HIS  HIS  PHE  LEU  MET  ALA  ASN  LEU  ALA  ASN
...          6431.SL (
...C A C C A T T C T T A A T G G C A A A T T T A G C C A A T
    ...                 340                 350                 360

GLU  GLN  ASN  GLN  THR  GLU  LEU  ALA  GLU  ARG ...
G A A C A A A A A T C A A A A C T G A A C T T G G C A G A A C G T ...
          370                 380                 390 ...

... TYR  SER  VAL  GLU  ASN  LEU  ALA  THR  LEU  ASN
...T A T T C A G T A G A A A A A C T T A G C A A C C T T A A A C
    ...                 400                 410                 420
```

FIG.25C

```
 GLY  TYR  CYS  GLN  MET  ARG  HIS  ASP  ILE  GLU  ...
G G C T A T T G C C A A A T G C G T C A C G A T A T T G A A ...
          430                 440                 450 ...

                                  ... PRO  ILE  GLU  SER  ASP  TYR  LEU  GLU  LEU  ARG
                                  ...C C C A T C G A A A G C G A T T A T T A G A A C T G C G T
                                  ...                 460                 470                 480

 LEU  ARG  ARG  TYR  LEU  THR  PHE  ALA  GLU  PHE  ...
T T A C G C C G T T A T T A A C T T T C G C C G A A T T T ...
          490                 500                 510 ...

                                  ... LYS  SER  GLU  LEU  ALA  PRO  HIS  PHE  GLY  LEU
                                  ...A A A T C A G A A T T A G C A C C G C A C T T T G G T C T T
                                  ...                 520                 530                 540

 GLY  LEU  GLU  GLY  TYR  ALA  THR  TRP  THR  SER  ...
G G T T T A G A A A G G C T A T G C C A C T T G G A C A T C G ...
          550                 560                 570 ...

                                  ... PRO  ILE  ARG  LYS  TYR  SER  ASP  MET  VAL  ASN
                                  ...C C C A T C C G C A A A T A T T C A G A T A T G G T T A A T
                                  ...                 580                 590                 600

 HIS  ARG  LEU  ILE  LYS  ALA  VAL  LEU  ALA  LYS  ...
                                                    ...
C A T C G C T T A A T C A A A G C C G T G C T G G C A A A A A ...
          610                 620                 630 ...
```

FIG.25D

```
... GLN  PRO  TYR  GLU  LYS  PRO  GLN  ASN  ASP  VAL
...
...C A G C C T T A T G A A A A A C C A C A A A A T G A C G T G
...            640             650             660

LEU  ALA  ARG  LEU  GLN  GLU  SER  ARG  ARG  GLN ...
_________6432.SL  (______________________________...
T T G G C A C G T T T G C A A G A G T C T C G C C G C C A A ...
          670             680             690 ...
... ASN  ARG  LEU  VAL  GLU  ARG  ASP  ILE  ALA  ASP
...
...A A T C G C C T A G T G G A A C G T G A T A T T G C C G A T
...            700             710             720

TRP  LEU  TYR  CYS  ARG  TYR  LEU  ALA  ASP  LYS ...
T G G C T A T A T T G C C G T T A T C T T G C T G A C A A A ...
          730             740             750 ...
... VAL  ALA  GLU  ASN  VAL  GLU  PHE  ASN  ALA  GLU
...G T G G C T G A A A A T G T G G A A T T T A A T G C A G A A
...            760             770             780

VAL  GLN  ASP  VAL  MET  ARG  ALA  GLY  LEU  ARG ...
G T G C A A G A T G T A A T G C G T G C A G G C T T A C G C ...
          790             800             810 ...
```

FIG.25E

```
... VAL  GLN  LEU  LEU  GLU  ASN  GLY  ALA  SER  LEU
...G T A C A A C T G C T C G A A A A T G G T G C A T C G C T A
                820                 830                 840
...                 ...                 ...                 ...

PHE  ILE  PRO  ALA  ALA  THR  LEU  HIS  ASN  ASN  ...
T T T A T T C C C T G C C C G C C A C G T T G C A C A A C A A C ...
                850                 860                 870 ...
... LYS  GLU  GLU  ILE  GLN  LEU  ASN  PRO  ASP  GLU
...A A A G A A G A A A A T A C A G C T A A A C C C T G A C G A A
                880                 890                 900
...                 ...                 ...                 ...

LEU  ALA  LEU  TYR  ILE  LYS  GLY  GLU  ARG  THR  ...
C T C G C C C T C T A T A T A A A A G G C G A A C G C A C T ...
                910                 920                 930 ...
... TYR  LYS  ILE  GLY  ASP  ILE  VAL  LYS  VAL  LYS
...T A C A A A A T A G G C G A C A T T G T G A A A G T G A A A A
                940                 950                 960
...                 ...                 ...                 ...

LEU  THR  GLU  VAL  LYS  GLU  ALA  THR  ARG  SER  ...
C T C A C A G A A G T G A A A G A A G C A A C T C G C A G T ...
                970                 980                 990 ...
... ILE  VAL  GLY  GLU  ILE  LEU  GLN  ***      LEU  PRO
...A T T G T G G G C G A A A T A C T T C A A A T A A A T T G C C
                1000                1010                1020
...                 ...                 ...
```

FIG.25F

```
     PHE  GLN  TYR  VAL  THR  GLU  ASP  GLY  LYS  THR...
G T T C C A A T A T G T T A C G G A A G A C G G C A A A A C ...
          1030                 1040                 1050 ...

...       VAL  VAL  LYS  VAL  GLY  ASN  GLU  TYR  TYR  GLU
...C G T T G T G A A A A G T G G G C A A T G A G T A T T A C G A
...                    1060                 1070                 1080

     ALA  LYS  GLN  ASP  GLY  SER  ALA  ASP  MET  ASP...
A G C C A A G C A A G A C G G T T C G G C G G A T A T G G A ...
                ( 6295.SL
          1090                 1100                 1110 ...

...       LYS  LYS  VAL  LYS  ASN  GLY  GLU  LEU  VAL  LYS
...T A A A A A A A G T C A A A A A A T G G C G A G C T G G T G A A
...                    1120                 1130                 1140

     THR  LYS  VAL  LYS  LEU  VAL  SER  ALA  ASN  GLY...
A A C T A A A A G T G A A A A T T G G T A T C G G C A A A C G G ...
          1150                 1160                 1170 ...

...       THR  ASN  PRO  VAL  LYS  ILE  SER  ASN  VAL  ALA
...T A C A A A A T C C G G G T G A A A A A T C A G C A A T G T T G C
...                    1180                 1190                 1200

     GLU  GLY  THR  GLU  ASP  THR  ASP  ALA  VAL  SER...
G G A A G G C A C G G A A G A T A C C G A T G C G G T C A G ...
          1210                 1220                 1230 ...
```

FIG.25G

```
                                  ...  PHE LYS GLN LEU LYS ALA LEU GLN ASN LYS
                                  ...C T T T A A G C A G T T G A A A G C C T T G C A A A A C A A
                                  ...           1240                1250               1260

 GLN VAL THR LEU SER ALA SER ASN ALA TYR...
A C A G G T T A C G T T A A G C G C G A G C A A T G C T T A ...
            1270                1280                1290 ...
                                  ...  ALA ASN GLY GLY SER ASP ALA ASP VAL GLY
                                  ...T G C C A A T G G C G G T A G C G A T G C C G A C G T C G G
                                  ...           1300                1310               1320

 LYS VAL THR GLN THR LEU SER ASN GLY LEU...
C A A G G T A A C T C A A A C T T T A A G C A A T G G T T T ...
            1330                1340                1350 ...
                                  ...  ASN PHE LYS PHE LYS SER THR ASP GLY GLU
                                  ...G A A T T T T A A A T T T A A A T C C A C A G A C G G C G A
                                  ...           1360                1370               1380

 LEU LEU ASN ILE LYS ALA ASP LYS ASP THR...
G T T G T T G A A C A T C A A A G C A G A C A A G G A C A C ...
            1390                1400                1410 ...
                                  ...  VAL THR ILE THR ARG ALA SER GLY ALA ASN
                                  ...G G T T A C C A T T A C G C G G G C A A G C G G T G C G A A
                                  ...           1420                1430               1440
```

FIG.25H

```
  GLY  ALA  ALA  ALA  THR  ASP  ALA  ASP  LYS  ILE...
T G G T G C G G C G C G A C T G A T G C C G A C A A G A T ...
      1450                 1460                 1470 ...

...                  LYS  VAL  ALA  SER  ASP  GLY  ILE  SER  ALA  GLY
...T A A A G T G G C T T C A G A C G G C A T T A G C G C G G G
...                  1480                 1490                 1500

  ASN  LYS  ALA  VAL  LYS  ASN  VAL  ALA  ALA  GLY...
T A A T A A A G C A G T T A A A A A C G T C G C G G C A G G ...
      1510                 1520                 1530 ...

...                  GLU  ILE  SER  ALA  THR  SER  THR  ASP  ALA  ILE
...C G A A A T T T C C G C C A C T T C C A C C G A T G C G A T
...                  ( 6271.SL
...                  1540                 1550                 1560

...                  GLY  VAL  THR  ASN  LEU  ALA  GLY  GLN  VAL  ASN
...G G G G G T A A C A A A C C T T G C T G G A C A A G T G A A
...                  1600                 1610                 1620

  LYS  VAL  GLY  LYS  ARG  ALA  ASP  ALA  GLY  THR...
T A A A G T G G G C A A A C G T G C A G A T G C A G G T A C ...
      1630                 1640                 1650 ...
```

FIG.25I

```
                                    ...  ALA  SER  ALA  LEU  ALA  ALA  SER  GLN  LEU  PRO
                                    ...A G C A A G T G C A T T A G C G G C T T C A C A G T T A C C
                                    ...                1660                1670                1680

  GLN  ALA  SER  MET  PRO  GLY  LYS  SER  MET  VAL...
A C A A G C C T C T A T G C C G G G T A A A T C A A T G G T ...
           1690                1700                1710 ...
                                    ...  SER  ILE  ALA  GLY  SER  SER  TYR  GLN  GLY  GLN
                                    ...T T C T A T T G C G G G A A G T A G T T A T C A A G G T C A
                                    ...                1720                1730                1740

  SER  GLY  LEU  ALA  ILE  GLY  VAL  SER  ARG  ILE...
A A G T G G T T T A G C T A T C G G G G T A T C A A G A A T ...
           1750                1760                1770 ...
                                    ...  SER  ASP  ASN  GLY  LYS  LEU  ILE  ILE  ARG  LEU
                                    ...T T C C G A T A A T G G C A A A T T G A T T A T T C G C T T
                                    ...                1780                1790                1800

  SER  GLY  THR  THR  ASN  SER  GLN  GLY  LYS  THR...
G T C A G G C A C A A C C A A T A G C C A A G G T A A A A C ...
           1810                1820                1830 ...
                                    ...  GLY  VAL  ALA  ALA  GLY  VAL  GLY  TYR  GLN  TRP
                                    ...A G G C G T T G C A G C A G G T G T T G G T T A C C A G T G
                                    ...                1840                1850                1860

  ***  ***
G T A A T A G A A T T C
           1870
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FIG.26A

```
                                                                    48
ATG AAC AAA ATT TTT AAC GTT ATT TGG AAT GTT GTG ACT CAA ACT TGG
Met Asn Lys Ile Phe Asn Val Ile Trp Asn Val Val Thr Gln Thr Trp
          2130                2135                2140

                                                                    96
GTT GTC GTA TCT GAA CTC ACT CGC ACC CAC ACC AAA TGC GCC TCC GCC
Val Val Val Ser Glu Leu Thr Arg Thr His Thr Lys Cys Ala Ser Ala
          2145                2150                2155

                                                                   144
ACC GTG GCG GTT GCC GTA TTG GCA ACC CTG TTG TCC GCA ACG GTT GAG
Thr Val Ala Val Ala Val Leu Ala Thr Leu Leu Ser Ala Thr Val Glu
2160                2165                2170                2175

                                                                   192
GCG AAC AAC AAT ACT CCT GTT ACG AAT AAG TTG AAG GCT TAT GGC GAT
Ala Asn Asn Asn Thr Pro Val Thr Asn Lys Leu Lys Ala Tyr Gly Asp
                    2180                2185                2190

                                                                   240
GCG AAT TTT AAT TTC ACT AAT AAT TCG ATA GCA GAT GCA GAA AAA CAA
Ala Asn Phe Asn Phe Thr Asn Asn Ser Ile Ala Asp Ala Glu Lys Gln
          2195                2200                2205

                                                                   288
GTT CAA GAG GCT TAT AAA GGT TTA TTA AAT CTA AAT GAA AAA AAT GCG
Val Gln Glu Ala Tyr Lys Gly Leu Leu Asn Leu Asn Glu Lys Asn Ala
          2210                2215                2220
```

FIG.26B

```
AGT GAT AAA CTG TTG GTG GAG GAC AAT ACT GCG GCG ACC GTA GGC AAT      336
Ser Asp Lys Leu Leu Val Glu Asp Asn Thr Ala Ala Thr Val Gly Asn
                2225                2230                2235

TTG CGT AAA TTG GGC TGG GTA TTG TCT AGC AAA AAC GGC ACA AGG AAC      384
Leu Arg Lys Leu Gly Trp Val Leu Ser Ser Lys Asn Gly Thr Arg Asn
2240                2245                2250                2255

GAG AAA AGC CAA CAA GTC AAA CAT GCG GAT GAA GTG TTG TTT GAA GGC      432
Glu Lys Ser Gln Gln Val Lys His Ala Asp Glu Val Leu Phe Glu Gly
                2260                2265                2270

AAA GGC GGT GTG CAG GTT ACT TCC ACC TCT GAA AAC GGC AAA CAC ACC      480
Lys Gly Gly Val Gln Val Thr Ser Thr Ser Glu Asn Gly Lys His Thr
                2275                2280                2285

ATT ACC TTT GCT TTA GCG AAA GAC CTT GGT GTG AAA ACT GCG ACT GTG      528
Ile Thr Phe Ala Leu Ala Lys Asp Leu Gly Val Lys Thr Ala Thr Val
                2290                2295                2300

AGT GAT ACC TTA ACG ATT GGC GGT GGT GCT GCT GCA GGT GCT ACA ACA      576
Ser Asp Thr Leu Thr Ile Gly Gly Gly Ala Ala Ala Gly Ala Thr Thr
                2305                2310                2315
```

FIG.26C

```
ACA CCG AAA GTG AAT GTA ACT AGT ACA ACT GAT GGC TTG AAG TTC GCT   624
Thr Pro Lys Val Asn Val Thr Ser Thr Thr Asp Gly Leu Lys Phe Ala
2320                2325                2330                2335

AAA GAT GCT GCG GGT GCT AAT GGC GAT ACT ACG GTT CAC TTG AAT GGT   672
Lys Asp Ala Ala Gly Ala Asn Gly Asp Thr Thr Val His Leu Asn Gly
                2340                2345                2350

ATT GGT TCA ACC TTG ACA GAC ACG CTT GTG GGT TCT CCT GCT ACT CAT   720
Ile Gly Ser Thr Leu Thr Asp Thr Leu Val Gly Ser Pro Ala Thr His
                2355                2360                2365

ATT GAC GGA GGA GAT CAA AGT ACG CAT TAC ACT CGT GCA GCA AGT ATC   768
Ile Asp Gly Gly Asp Gln Ser Thr His Tyr Thr Arg Ala Ala Ser Ile
                2370                2375                2380

AAG GAT GTC TTG AAT GCG GGT TGG AAT ATC AAG GGT GTT AAA GCT GGC   816
Lys Asp Val Leu Asn Ala Gly Trp Asn Ile Lys Gly Val Lys Ala Gly
2385                2390                2395

TCA ACA ACT GGT CAA TCA GAA AAT GTC GAT TTT GTT CAT ACT TAC GAT   864
Ser Thr Thr Gly Gln Ser Glu Asn Val Asp Phe Val His Thr Tyr Asp
2400                2405                2410                2415
```

FIG.26D

```
ACT GTT GAG TTC TTG AGT GCG GAT ACA GAG ACC ACG ACT GTT ACT GTA      912
Thr Val Glu Phe Leu Ser Ala Asp Thr Glu Thr Thr Thr Val Thr Val
                2420                2425                2430

GAT AGC AAA GAA AAC GGT AAG AGA ACC GAA GTT AAA ATC GGT GCG AAG      960
Asp Ser Lys Glu Asn Gly Lys Arg Thr Glu Val Lys Ile Gly Ala Lys
                2435                2440                2445

ACT TCT GTT ATC AAA GAA AAA GAC GGT AAG TTA TTT ACT GGA AAA GCT     1008
Thr Ser Val Ile Lys Glu Lys Asp Gly Lys Leu Phe Thr Gly Lys Ala
                2450                2455                2460

AAC AAA GAG ACA AAT AAA GTT GAT GGT GCT AAC GCG ACT GAA GAT GCA     1056
Asn Lys Glu Thr Asn Lys Val Asp Gly Ala Asn Ala Thr Glu Asp Ala
                2465                2470                2475

GAC GAA GCC AAA GGC TTA GTG ACT GCG AAA GAT GTG ATT GAC GCA GTG     1104
Asp Glu Gly Lys Gly Leu Val Thr Ala Lys Asp Val Ile Asp Ala Val
                2480                2485                2490                2495

AAT AAG ACT GGT TGG AGA ATT AAA ACA ACC GAT GCT AAT GGT CAA AAT     1152
Asn Lys Thr Gly Trp Arg Ile Lys Thr Thr Asp Ala Asn Gly Gln Asn
                2500                2505                2510
```

FIG.26E

```
GGC GAC TTC GCA ACT GTT GCA TCA GGC ACA AAT GTA ACC TTT GCT AGT   1200
Gly Asp Phe Ala Thr Val Ala Ser Gly Thr Asn Val Thr Phe Ala Ser
                2515                2520                2525

GGT AAT GGT ACA ACT GCG ACT GTA ACT AAT GGC ACC GAT GGT ATT ACC   1248
Gly Asn Gly Thr Thr Ala Thr Val Thr Asn Gly Thr Asp Gly Ile Thr
                2530                2535                2540

GTT AAG TAT GAT GCG AAA GTT GGC GAC GGC TTA AAA CTA GAT GGC GAT   1296
Val Lys Tyr Asp Ala Lys Val Gly Asp Gly Leu Lys Leu Asp Gly Asp
                2545                2550                2555

AAA ATC GCT GCA GAT ACG ACC GCA CTT ACT GTG AAT GAT GGT AAG AAC   1344
Lys Ile Ala Ala Asp Thr Thr Ala Leu Thr Val Asn Asp Gly Lys Asn
2560                2565                2570                2575

GCT AAT AAT CCG AAA GGT AAA GTG GCT GAT GTT GCT TCA ACT GAC GAG   1392
Ala Asn Asn Pro Lys Gly Lys Val Ala Asp Val Ala Ser Thr Asp Glu
                2580                2585                2590

AAG AAA TTG GTT ACA GCA AAA GGT TTA GTA ACA GCC TTA AAC AGT CTA   1440
Lys Lys Leu Val Thr Ala Lys Gly Leu Val Thr Ala Leu Asn Ser Leu
                2595                2600                2605
```

FIG.26F

```
AGC TGG ACT ACA ACT GCT GCT GAG GCG GAC GGT GGT ACG CTT GAT GGA   1488
Ser Trp Thr Thr Thr Ala Ala Glu Ala Asp Gly Gly Thr Leu Asp Gly
                2610                2615                2620

AAT GCA AGT GAG CAA GAA GTT AAA GCG GGC GAT AAA GTA ACC TTT AAA   1536
Asn Ala Ser Glu Gln Glu Val Lys Ala Gly Asp Lys Val Thr Phe Lys
                2625                2630                2635

GCA GGC AAG AAC TTA AAA GTG AAA CAA GAG GGT GCG AAC TTT ACT TAT   1584
Ala Gly Lys Asn Leu Lys Val Lys Gln Glu Gly Ala Asn Phe Thr Tyr
                2640                2645                2650                2655

TCA CTG CAA GAT GCT TTA ACA GGC TTA ACG AGC ATT ACT TTA GGT ACA   1632
Ser Leu Gln Asp Ala Leu Thr Gly Leu Thr Ser Ile Thr Leu Gly Thr
                2660                2665                2670

GGA AAT AAT GGT GCG AAA ACT GAA ATC AAC AAA GAC GGC TTA ACC ATC   1680
Gly Asn Asn Gly Ala Lys Thr Glu Ile Asn Lys Asp Gly Leu Thr Ile
                2675                2680                2685

ACA CCA GCA AAT GGT GCG GGT GCA AAT AAT GCA AAC ACC ATC AGC GTA   1728
Thr Pro Ala Asn Gly Ala Gly Ala Asn Asn Ala Asn Thr Ile Ser Val
                2690                2695                2700
```

FIG.26G

```
ACC AAA GAC GGC ATT AGT GCG GGC GGT CAG TCG GTT AAA AAC GTT GTG   1776
Thr Lys Asp Gly Ile Ser Ala Gly Gly Gln Ser Val Lys Asn Val Val
        2705                2710                2715

AGC GGA CTG AAG AAA TTT GGT GAT GCG AAT TTC GAT CCG CTG ACT AGC   1824
Ser Gly Leu Lys Lys Phe Gly Asp Ala Asn Phe Asp Pro Leu Thr Ser
        2720                2725                2730        2735

TCC GCC GAC AAC TTA ACG AAA CAA AAT GAC GAT GCC TAT AAA GGC TTG   1872
Ser Ala Asp Asn Leu Thr Lys Gln Asn Asp Asp Ala Tyr Lys Gly Leu
                2740                2745                2750

ACC AAT TTG GAT GAA AAA GGT ACA GAC AAG CAA ACT CCA GTT GTT GCC   1920
Thr Asn Leu Asp Glu Lys Gly Thr Asp Lys Gln Thr Pro Val Val Ala
                2755                2760                2765

GAC AAT ACC GCC GCA ACC GTG GGC GAT TTG CGC GGC TTG GGC TGG GTC   1968
Asp Asn Thr Ala Ala Thr Val Gly Asp Leu Arg Gly Leu Gly Trp Val
                2770                2775                2780

ATT TCT GCG GAC AAA ACC ACA GGC GGC TCA ACG GAA TAT CAC GAT CAA   2016
Ile Ser Ala Asp Lys Thr Thr Gly Gly Ser Thr Glu Tyr His Asp Gln
                2785                2790                2795
```

FIG.26H

```
GTT CGG AAT GCG AAC GAA GTG AAA TTC AAA AGC GGC AAC GGT ATC AAT   2064
Val Arg Asn Ala Asn Glu Val Lys Phe Lys Ser Gly Asn Gly Ile Asn
2800                2805                2810                2815

GTT TCC GGT AAA ACG GTC AAC GGT AGG CGT GAA ATT ACT TTT GAA TTG   2112
Val Ser Gly Lys Thr Val Asn Gly Arg Arg Glu Ile Thr Phe Glu Leu
                2820                2825                2830

GCT AAA GGT GAA GTG GTT AAA TCG AAT GAA TTT ACC GTC AAA GAA ACC   2160
Ala Lys Gly Glu Val Val Lys Ser Asn Glu Phe Thr Val Lys Glu Thr
                2835                2840                2845

AAT GGA AAG GAA ACG AGC CTG GTT AAA GTT GGC GAT AAA TAT TAC AGC   2208
Asn Gly Lys Glu Thr Ser Leu Val Lys Val Gly Asp Lys Tyr Tyr Ser
                2850                2855                2860

AAA GAG GAT ATT GAC TTA ACA ACA GGT CAG CCT AAA TTA AAA GAT GGC   2256
Lys Glu Asp Ile Asp Leu Thr Thr Gly Gln Pro Lys Leu Lys Asp Gly
2865                2870                2875

AAT ACA GTT GCT GCG AAA TAT CAA GAT AAA GGT GGC AAA GTC GTT TCT   2304
Asn Thr Val Ala Ala Lys Tyr Gln Asp Lys Gly Gly Lys Val Val Ser
2880                2885                2890                2895
```

FIG.26I

```
GTA ACG GAT AAT ACT GAA GCT ACC ATA ACC AAC AAA GGT TCT GGC TAT   2352
Val Thr Asp Asn Thr Glu Ala Thr Ile Thr Asn Lys Gly Ser Gly Tyr
            2900                2905                2910

GTA ACA GGT AAC CAA GTG GCA GAT GCG ATT GCG AAA TCA GGC TTT GAG   2400
Val Thr Gly Asn Gln Val Ala Asp Ala Ile Ala Lys Ser Gly Phe Glu
            2915                2920                2925

CTT GGC TTG GCT GAT GAA GCT GAT GCG AAA CGG GCG TTT GAT GAT AAG   2448
Leu Gly Leu Ala Asp Glu Ala Asp Ala Lys Arg Ala Phe Asp Asp Lys
            2930                2935                2940

ACA AAA GCC TTA TCT GCT GGT ACA ACG GAA ATT GTA AAT GCC CAC GAT   2496
Thr Lys Ala Leu Ser Ala Gly Thr Thr Glu Ile Val Asn Ala His Asp
            2945                2950                2955

AAA GTC CGT TTT GCT AAT GGT TTA AAT ACC AAA GTG AGC GCG GCA ACG   2544
Lys Val Arg Phe Ala Asn Gly Leu Asn Thr Lys Val Ser Ala Ala Thr
2960                2965                2970                2975

GTG GAA AGC ACC GAT GCA AAC GGC GAT AAA GTG ACC ACA ACC TTT GTG   2592
Val Glu Ser Thr Asp Ala Asn Gly Asp Lys Val Thr Thr Thr Phe Val
            2980                2985                2990
```

FIG.26J

```
                                                                2640
AAA ACC GAT GTG GAA TTG CCT TTA ACG CAA ATC TAC AAT ACC GAT GCA
Lys Thr Asp Val Glu Leu Pro Leu Thr Gln Ile Tyr Asn Thr Asp Ala
          2995                3000                3005

                                                                2688
AAC GGT AAG AAA ATC ACT AAA GTT GTC AAA GAT GGG CAA ACT AAA TGG
Asn Gly Lys Lys Ile Thr Lys Val Val Lys Asp Gly Gln Thr Lys Trp
          3010                3015                3020

                                                                2736
TAT GAA CTG AAT GCT GAC GGT ACG GCT GAT ATG ACC AAA GAA GTT ACC
Tyr Glu Leu Asn Ala Asp Gly Thr Ala Asp Met Thr Lys Glu Val Thr
          3025                3030                3035

                                                                2784
CTC GGT AAC GTG GAT TCA GAC GGC AAG AAA GTT GTG AAA GAC AAC GAT
Leu Gly Asn Val Asp Ser Asp Gly Lys Lys Val Val Lys Asp Asn Asp
3040                3045                3050                3055

                                                                2832
GGC AAG TGG TAT CAC GCC AAA GCT GAC GGT ACT GCG GAT AAA ACC AAA
Gly Lys Trp Tyr His Ala Lys Ala Asp Gly Thr Ala Asp Lys Thr Lys
          3060                3065                3070

                                                                2880
GGC GAA GTG AGC AAT GAT AAA GTT TCT ACC GAT GAA AAA CAC GTT GTC
Gly Glu Val Ser Asn Asp Lys Val Ser Thr Asp Glu Lys His Val Val
          3075                3080                3085
```

FIG.26K

```
AGC CTT GAT CCA AAT GAT CAA TCA AAA GGT AAA GGT GTC GTG ATT GAC  2928
Ser Leu Asp Pro Asn Asp Gln Ser Lys Gly Lys Gly Val Val Ile Asp
                3090                3095                3100

AAT GTG GCT AAT GGC GAT ATT TCT GCC ACT TCC ACC GAT GCG ATT AAC  2976
Asn Val Ala Asn Gly Asp Ile Ser Ala Thr Ser Thr Asp Ala Ile Asn
                3105                3110                3115

GGA AGT CAG TTG TAT GCT GTG GCA AAA GGG GTA ACA AAC CTT GCT GGA  3024
Gly Ser Gln Leu Tyr Ala Val Ala Lys Gly Val Thr Asn Leu Ala Gly
3120                3125                3130                3135

CAA GTG AAT AAT CTT GAG GGC AAA GTG AAT AAA GTG GGC AAA CGT GCA  3072
Gln Val Asn Asn Leu Glu Gly Lys Val Asn Lys Val Gly Lys Arg Ala
                3140                3145                3150

GAT GCA GGT ACA GCA AGT GCA TTA GCG GCT TCA CAG TTA CCA CAA GCC  3120
Asp Ala Gly Thr Ala Ser Ala Leu Ala Ala Ser Gln Leu Pro Gln Ala
                3155                3160                3165

ACT ATG CCA GGT AAA TCA ATG GTT GCT ATT GCG GGA AGT AGT TAT CAA  3168
Thr Met Pro Gly Lys Ser Met Val Ala Ile Ala Gly Ser Ser Tyr Gln
                3170                3175                3180
```

FIG.26L

```
GGT CAA AAT GGT TTA GCT ATC GGG GTA TCA AGA ATT TCC GAT AAT GGC   3216
Gly Gln Asn Gly Leu Ala Ile Gly Val Ser Arg Ile Ser Asp Asn Gly
     3185                3190                3195

AAA GTG ATT ATT CGC TTG TCA GGC ACA ACC AAT AGT CAA GGT AAA ACA   3264
Lys Val Ile Ile Arg Leu Ser Gly Thr Thr Asn Ser Gln Gly Lys Thr
3200                3205                3210                3215

GGC GTT GCA GCA GGT GTT GGT TAC CAG TGG                          3294
Gly Val Ala Ala Gly Val Gly Tyr Gln Trp
                3220                3225
```

FIG.27A

Alignment of NTHi strain 12 5' ORF with HI1733 from H. influenzae strain Rd

FIG.27B

```
290            300            310            320            330
LNPDELALYIKGERTYKIGDIVKVKLTEVKEATRSIVGEILQ
||||||||||||||||||| ||||||||||||||||||||||
LNPDELALYIKGERTYKIGDMVKVKLTEVKEATRSIVGEILQ
620            630            640            650            X
```

```
;        ##cross-references GB:L42023; TIGR:HI1733
;        ##note          named as homolog to a protein from Escherichia coli
; SUMMARY           #length 659  #molecular-weight 75782  #checksum 8365
```

A64139

```
MFQDNPLLAQLKQQIHDSKEQVEGVVKSTDKAYGFLECDKKTYFIAPPSMKKVMHGDKIKATIEKQGDKE
QAEPEALIEPMLTRFIAKVRFNKDKKLQVLVDHPSINQPIGAQQAKSVKEELQEGDWVVANLKTHPLRDD
RFFYATINQLICRADDELAPWWVTLARHEQSRYPVRGAEPYEMLDQKTRENLTALHFVTIDSESTMDMDD
ALYIEPIAQNSTQTGWKLVVAIADPTAYIALDSQIEQEAKQRCFTNYLPGFNIPMLPRELSDELCSLIAN
EIRPALVCYIETDLTGNITAKPHFVSAYVQSKAKLAYNKVSDYLEQADNAWQPEMPETAQQIHWLHQFTK
ARIQWRKTHSLFFKEKPDYAFVLAENGKVQEIKAEYRRIANQIVEEAMIIANICAAQFLHEQAKTGIFNT
HSGFDKKFLENAHNFLMANLANEQNQTELAERYSVENLATLNGYCQMRHDIEPIESDYLELRLRRYLTFA
EFKSELAPHFGLGLEGYATWTSPIRKYSDMVNHRLIKAVLAKQPYEKPQNDVLARLQEARRQNRLVERDI
ADWLYCRYLADKVASNAEFEAEVQDVMRAGLRVQLLENGASLFIPAATLHNNKEEIQLNPDELALYIKGE
RTYKIGDMVKVKLTEVKEATRSIVGEILQ
```

FIG.28A

Alignment of *H. influenzae* Hia/Hsf and *M. catarrhalis* 200 kDa proteins

```
         10        20        30        40        50
MNKIFNVIWNVMTQTWAVVSELTRAHTKRASATVAAAVLATVLSATVQA-S-----------...
...........V...V.......T..C......V.....L.......N------------...
...........V...V...........C......V.....A....AE.NN-----------...
...........V...V...........C......V.....A....AE.NN-----------...
..................................T.....L..T....TT-----------...
...........V...V.......T..C......V.....L.....E.NN-----------...
..................................T.....Q....AE.NS-----------...
.....N..........V.......T.........ET.....L.F.....NATDEDEELDPVV...
................V.......T.........ET.....L.F.....NATDEDEELDPVV...
.....K.....V...V...........T.....T.............IN---------DA...
..H.YK..F.KA.G.FMA.A.YAKS.STGGGSCATGQ.GSVCTLSFARIAALAVLVIGATLS...
..H.YK..F.KA.G.FMA.A.CAKS.SGGSSSSTAGQ.GSSPVIRLTRVATLAILVIGATLN...
** ** ****  * **  *** *****  ***  *  * *
                                                             ...
...
...-------------------------------------------  33
...-------------------------------------------  32
...-------------------------------------------  29
...-------------------------------------------  K22
...-------------------------------------------  M4071
...-------------------------------------------  11
...-------------------------------------------  K9
...RTAPVLSFHSDKEGTGEKEVTENSNWGIYFDNKGVLKA--------  HSF
```

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FIG.28B

```
...RTAPVLSFHSDKEGTGEKEVTENSNWGIYFHNKGVLKA--------    API
...GTFVKVQSTEDDIEDSAATKDDNKNQALKAGDTLTLKA--------    Rd
...GSAYAQKKDTKHIAIGEQNQPRRSGTAKADGDRAIAIGENANAQGG    4223
...GSAYAQN-NSK-AIFGTTGNNDN---ASASNEASIAIGSLAKAHAN    LES-1
...          *      *           *     *      *

--------------------------------------------------------...
--------------------------------------------------------...
--------------------------------------------------------...
--------------------------------------------------------...
--------------------------------------------------------...
--------------------------------------------------------...
--------------------------------------------------------...
GAITLKAGDNLKIKQNTDESTNASSFTYSLKKDLTDLTSVATEKLSFGANGDKVDITSDANG...
GAITLKAGDNLKIKQ----STNASSFTYSLKKDLTDLTSVATEKLSFGANGDKVDITSDANG...
GKN-LKAKLDQGGKSVTFALAKDLDVKTAKVSDTLTIGGNTPAAGGATP---KVSITSTADG...
QAIAIGSSNKTVNG-SSLDKIGTDITGQESIAIGGDVKASGDASIAIGSDDLHLLDQHGNPK...
QAIAIGGSKPDPRNQAANQKAGSHAKGKESIAIGGDVLAEGDASIAIGSDDLYLDRNSTNSK...
  **          *                      ****  ***   *
                                                                ...
...-----------------------------------------------    33
...-----------------------------------------------    32
...-----------------------------------------------    29
...-----------------------------------------------    K22
...-----------------------------------------------    M4071
...-----------------------------------------------    11
```

FIG.28C

```
...-------------------------------------------------------  K9
...LKLAKTGNGN--VHLNGLDSTLPDAVTNTGVLSSSS-FTPNDVEKTR         HSF
...LKLAKTGNGN--VHLNGLDSTLPDAVTNTGVLSSSS-FTPNDVEKTR         API
...LKLAKGTNGDTAVHLNGLASTLPDVTTNTGASTSVT-FSPSDIEKTR         Rd
...HPKGTLINDLINGHAVLKEIRSSKDNDVKYRRTTASGHASTAVGAMS         4223
...YPNGLLSTLIQN-HTVLRQIRDSNGSQ-KYRRTAAEGHASTAVGAMA         LES-1
...    *          *                   **   **   *

-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
AATVKDVLNAGWNIKGAKTAGGNVESVDLVSAYNNVEFITGDKNTLDVVLTAKENGKTTEVK ...
AATVKDVLNAGWNIKGAKTAGGNVESVDLVSAYNNVEFITGDKNTLDVVLTAKENGKTTEVK...
AATIKDVLNAGWNIKGAKVAGGNTESVDLVAGYDNVEFITGDKNTLDVVLTAKENGKTTEVK...
YAQGHFSNAFGTRA-TAKSAYSLAVGLAATAEGQSTIAIGSDATSSSLGAIALGAGTRAQLQ...
YAKGHFANAFGTRS-TAEGNYSKAVGLTAKAEKGYTIAIGSNAQAINYGALALGADTRVDLD...
*         *   ***     *     *    *        ****  *       *       **  ...

...------------------------------------------------------  33
...------------------------------------------------------  32
...------------------------------------------------------  29
...------------------------------------------------------  K22
```

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FIG.28D

```
...--------------------------------------------------      M4071
...--------------------------------------------------      11
...--------------------------------------------------      K9
...FTPKT---SVIKEKD----GKLFTGKENNDTNKV--TSNTA--------      HSF
...FTPKT---SVIKEKD----GKLFTGKENNDTNKV--TSNTA--------      API
...FTPKT---SVIKDNN----GKLLTGKQLKDANIG--TATNA--------      Rd
...GSIALGQGSVVTQSD-NNSRPAYTPNTQALDPKFQ-ATNNTKAGPLSIG      4223
...YGIALGYGSQILNNNNNNNNKAYVPEGNGSNIKSSKATGNGLF---SIG      LES-1
... *      * * * *                        **  *

-----------------------------------------------------------...
-----------------------------------------------------------...
-----------------------------------------------------------...
-----------------------------------------------------------...
-----------------------------------------------------------...
-----------------------------------------------------------...
-----------------------------------------------------------...
TDNTDEGNGLVTAKAVI-DAVNKAGWTVKTTTANGQNGDFATVASGTNVTFESGDGTTASVT...
TDNTDEGNGLVTAKAVI-DAVNKAGWTVKTTTANGQNGDFATVASGTNVTFESGDGTTASVT...
TEDTDEAMA*                                                    ...
 *RYRRGNGLVTAKTVI-EAVNKSGWRVKTTTANGQNDDFATVASGTNVTFANGNGTTASVT...
SNSIKRKIINVGAGVNKTDAVNVAQLEAVVKWAKERRITFQGDDNSTDVKIGLDNTLTIKGG...
SSTIKRKIINVGAGYEDTDAVNVAQLKAVENLAK-RQITFKGDDNGTGVKKKLGETLTIKGG...
*        ***     **** *       *      * *   ** *     ** *    *...

...--------------------------------------------                  33
```

FIG.28E

```
...--------------------------------------------------   32
...--------------------------------------------------   29
...--------------------------------------------------   K22
...--------------------------------------------------   M4071
...--------------------------------------------------   11
...--------------------------------------------------   K9
...KDINGNGITVKYD-ALVGDGLKFDSDKKIVADITALTVTG----         HSF
...KDINGNGITVKYD-ALVGDGLKFDSDKKIVADITALTVTG----         API
...                                                     Rd
...NSTD--GITVKYE-ALVGDGLKIDGDQKIVADITALTVTG----         Rd
...AETNA--LTDNN- IGVVKEADNSGLKVKLAKTLNNLTEVTTTL         4223
...-ETQADKLTDNNNIGVVTD-NNTGLKVKLAKNLSGLETVSTKNL         LES-1
...  **** **   * * * **      **     *

--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
GKVAEIAKEDDKKKLVNAGDLVTALGNLSWKAKAEADTD--GALEGISKDQEVKAGETVTFK...
GKVAEIAKEDDKKKLVNAGDLVTALGNLSWKAKAEADTDTDGALEGISKDQEVKAGETVTFK...
GKVAEIAKEDDKKKLVNAGDLVTALGNLSWKAKAEADTD--GALEGTSKDQEVKAGETVTFK...
NATTTVKVGSSSSTTAELLSDSLTFTQPNTGSQSTSKTVYGVNGVKFTNNAETTAAIGTT-R...
```

FIG.28F

```
TASEKVTVGSGNN-TAELQSGGLTFT-PTINA-STDKTVYGTDGLKFTDNSN-TALEDTT-R...
      *         *       * **     * *    *  *      * * *   *     * *...
                                  ...---------------------------------------   33
                                  ...---------------------------------------   32
                                  ...---------------------------------------   29
                                  ...---------------------------------------   K22
                                  ...---------------------------------------   M4071
                                  ...---------------------------------------   11
                                  ...---------------------------------------   K9
                                  ...AGKNLKVKQDGANFTYSLQDALTGLTSATLGGTTNGGNDA  HSF
                                  ...AGKNLKVKQDGANFTYSLQDALTGLTSATLGGTTNGGNDA  API
                                  ...AGKNLKVKQDGANFTYSLQDALTGLTSATLGGTTNGGNDA  Rd
                                  ...ITRDKIGFARD-GDVDE----------------------   4223
                                  ...ITKDKIGFSNKAGTVDENKPYLDKDKLKVGNSTLNNGGLT  LES-1
                                  ...  ***        *         *         ** * *  *

                                      60        70       ...
 ------------------------------AGSTTGTNSLNVYGK-NNSNFNSANNSIA...
 -------------------------------------------------------------...
 ------------------------------NN--.SV..G..A..D---T...TT........
 ------------------------------N--.SV..G..A..D---T...TT........
 ------------------------------T.G..S..G.KA..ST..P...A.G..AT...
 ------------------------------N--.PV..K.KA..D-A.F..--T........
 --------------------------------.ASV.CR.....D-T.TK..A.........
KTVINKDGLTITPAGNGGTTGTNTISBTKDGIK..NKAI..VASGLRAYDDA..DVL...AT...
```

FIG.28G

```
KTVINKDGLTITPAGNGGTTGTNTISBTKDGIK..NKAI..VASGLRAYDDA..DVL...AT...
KTVINKDGLTITPAGNGGTTGTNTISBTKDGIK..NKAI..VASGLRAYDDA..DVL...AT...
-------------------------------------------------------------...
-------------VNNTIGGSNKQIQVGADGIKFADVNVNVSNAAKFGTTRITEEEIGFAD....
              ** ***  * ** **** *                       * *...

                        ...80       90       100       110       120
                        ...DLNKQNDSVYDGLLNLNEKGTDKSKFLVADETTATVGNLRKL------   33
                        ...---------------------ATDENED..EELEPVQRSV.------   32
                        .....E.HVQDA.K........D.N..S.....N.A.........------   29
                        .....E.HVQDA.K........D.N..S.....N.A.........------   K22
                        .....AR.F.GA..........DAN.N-L..T.DKA.........------   M4071
                        ....AE..VQEA.K........NAS-D.L..E.N.A....D....------   11
                        ..........G.H........N.AN.-.L..D.N.A....D....------   K9
                        ......RHVEDA.K........NAN.QP-..T.S.A....D....------   HSF
                        ......RHVEDA.K........NAN.QP-..TDS.A....D....------   API
                        ......RHVEDA.K........NAN.QP-....S.A....D....------   Rd
                        ...-----KQAP.LDKKQ.KVGSVAITIDNGI.AGNKKIS..A.GSSANDA   4223
                        ....GKVDKK.P.LDKKQ.QVG.VKIT.DSGINAGDQKISNVKDATDDTDA   LES-1
                        ...*        *    **            *       *

      130        140        150      160
                                                   ...
GWVVSTKNSTKEE-SNQVKQADEVLFEG-KDGVTVTSKSENGKHTVT---------------...
R.SFKSAKEGTG.QEGTTEV------------------------------------------...
...L.S..G.RN.K.Y..........T.-SGAA..S.S.KD....I.---------------...
...L.S..G.RN.K.Y..........T.-SGAA..S.S.KD....I.---------------...
```

FIG.28H

```
...L.S..G.RN.K.Q...H........-..................----------------...
...L.S..G.RN.K.Q...H........-.G..Q...T.......I.----------------...
........GKEN.K.Q..........K.S.G..Q...T......AI.----------------...
........G....-............T.-AGAA............I.VSVAETKADCGLEKD...
........G....-............T.-AGAA............I.VSVAETKADSGLEKD...
........G....-............T.-AGAA............I.VSVAETKADSGLEKD...
VTIEQL.AAKPTLNAGAGISVTPTEISVDAKSGN..APTY.IGVKT.ELNSDGTSDKFSVKG...
VTYKQL.---------------------------------------------------------...
                *  *** * *     *    ** **    *  ...

...
...------------------------------------------------   33
...------------------------------------------------   32
...------------------------------------------------   29
...------------------------------------------------   K22
...------------------------------------------------   M4071
...------------------------------------------------   11
...------------------------------------------------   K9
...GDTIKLKVDNQNTDNVLTVGNNGTAVTKGGFETVKTGATDADRGKVT   HSF
...GDTIKLKVDNQNTDNVLTVGNNGTAVTKGGFETVKTGATDADRGKVT   API
...GDTIKLKVDNQNTDNVLTVGNNGTAVTKGGFETVKTGATDADRGKVT   Rd
...SGTNNSLVTAEHLASYLNEVNRTADSALQSF-TVKEED-DDDANAIT   4223
...-----------------QVQQDADGALQSF-SIRDEK-GQEFTISN   LES-1
...* *   *  *    *   *  *    ******   *  *

-----------------------------------------------------------------.:.
```

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FIG.28I

```
------------------------------------------------------------...
------------------------------------------------------------...
------------------------------------------------------------...
------------------------------------------------------------...
------------------------------------------------------------...
------------------------------------------------------------...
VKDATANDADKKVATVKDVATAINSAATFVKTENLTTSIDEDNPTDNGKDDALKAGDTLTFK...
VKDATANDADKKVATVKDVATAINSAATFVKTENLTTSIDEDNPTDNGKDDALKAGDTLTFK...
VKDATANDADKKVATVKDVATAINSAATFVKTENLTTALDEADAKDQG-DDALKAGDTLTFK...
VAKDTTKNAGAVSILKLKGKNGLTVATKKD-GTVTFGLSQDSGLTIGKSTLNNDGLTVKDTN...
LYSNGNTPNTFETITFA-GENGISISNDIAKGKVKVGIDPINGLTTPKLTVGSDKDGKTQLV...
*  *            ** *   **   *                                 ...

...-----------------------------------------------------   33
...-----------------------------------------------------   32
...-----------------------------------------------------   29
...-----------------------------------------------------   K22
...-----------------------------------------------------   M4071
...-----------------------------------------------------   11
...-----------------------------------------------------   K9
...AGKNLKVKRDGKNITFDLAKNLEVKTAKVSDTLTIGGNTPTGGTTAT--   HSF
...AGKNLKVKRDGKNITFDLAKNLEVKTAKVSDTLTIGGNTPTGGTTAT--   API
...AGKNLKVKRDGKNITFDLAKNLEVKTATFSDRLTIG-------------   Rd
...-EQIQVGANGI.FTNVNGSNPGTGIANTARITRDKIGFAGSDGAVDTNK   4223
...IEQVASGN-.T...IR---------------------------------   LES-1
...          *  **    *        * * * ** *
```

FIG.28J

```
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
PKVNITSTADGLNFAKETADASGSKNVYLKGIATTLTEPSAGAKSSHVDLNVDATK-KSNAA...
PKVNITSTADGLNFAKETADASGSKNVYLKGIATTLTEPSAGAKSSHVDLNVDATK-KSNAA...
--------------------------------------------------------------...
PYLDQDKLQVGNVKITNTGINAGGKAITGLSPTLPSIADQSS-RNIELGNTI-QDKDKSNAA...
----------------------------GLSPTL[SITNAGGVRTTEQGNTITSDEDKSKAA...
* **       *     ***  **** *   * *        ** *  .    *    *** **...

                        ...------------------------------------------------   33
                        ...------------------------------------------------   32
                        ...------------------------------------------------   29
                        ...------------------------------------------------   K22
                        ...------------------------------------------------   M4071
                        ...------------------------------------------------   11
                        ...------------------------------------------------   K9
                        ...SIEDVLRAGWINQGNGNNVDYVATYDTVNFTDDSTGTTTVTVTQKADG   HSF
                        ...SIEDVLRAGWINQGNGNNVDYVATYDTVNFTDDSTGTTTVTVTQKADG   API
                        ...------------------------------------------------   Rd
                        ...SINDILNTGFNLKNNSNSVGFVSTYNTVDFIDGNATTAKVTY-DETNQ   4223
                        ...SIGDILNTGFNLKNNSNSVGFVSTYNTVDFIDGNATTAKVTY-TETNQ   LES-1
```

FIG.28K

```
                                     ...** *** *****  * * * ****** *** *  **** ***  * **

--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
KGADVKIGAKTSVIKDHNGKLFTGKDLKDANNGATVSEDDGKDTGTGLVTAKTVIDAVNKSG...
KGADVKIGAKTSVIKDHNGKLFTGKDLKDANNGATVSEDDGKDTGTGLVTAKTVIDAVNKSG...
--------------------------------------------------------------...
TSKVVYDVNVDDTTIHLTGTDDNK-KLGVKTTKLNKTDANGNTATNFNVNSSDEDALVNAKD...
TSKVTYDVNVDEKTIELTGDNGKTNKIGVKTTTLTTINANGK-ATNF-STTDNDALVNAKDI...
 *                *                  *  **  **   * *      **   ...

                            ...---------------------------------------------------   33
                            ...---------------------------------------------------   32
                            ...---------------------------------------------------   29
                            ...---------------------------------------------------   K22
                            ...---------------------------------------------------   M4071
                            ...---------------------------------------------------   11
                            ...---------------------------------------------------   K9
                            ...WRVTGEGATAETGATAVNAGNAETVTSGTSVNFKNGNATTATVSKDNGNIN   HSF
                            ...WRVTGEGATAETGATAVNAGNAETVTSGTSVNFKNGNATTATVSKDNGNIN   API
                            ...---------------------------------------------------   Rd
```

FIG.28L

```
                         ...IAENLNTLAKEIHTTKGTADTALQTFTVKKVDENNNADDANAIT-------   4223
                         ...AENLNTLAKEIHTTKGTADTALQTFKVKK-----DGATDDETIT-------   LES-1
                         ...     ** * *  **   *  *           *       ***

-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
VKYDVNVGDGLKIGDDKKIVADTTTLTVTGGKVSVPAGANSVNNNKKLVNAEGLATALNNLS...
VKYDVNVGDGLKIGDDKKIVADTTTLTVTGGKVSVPAGANSVNNNKKLVNAEGLATALNNLS...
-------------------------------------------------------------...
VGQKNANNQ--VNTLTLKGENGLNIKTDKNGTVTFGIN-----------------------...
VGKDGTQNGKTVNTLKLKGENGLTVATNKDGTVTFGIN-----------------------...
*             *   *         *   * **                          ...

                         ...--------------------------------------------------   33
                         ...--------------------------------------------------   32
                         ...--------------------------------------------------   29
                         ...--------------------------------------------------   K22
                         ...--------------------------------------------------   M4071
                         ...--------------------------------------------------   11
                         ...--------------------------------------------------   K9
                         ...WTAKADKYADGESEGETDQEVKAGDKVTF-KAGKNLKVKQSEKDFTYSLQD   HSF
```

FIG.28M

```
...WTAKADKYADGESEGETDQEVKAGDKVTF-KAGKNLKVKQSEKDFTYSLQD   API
...---------------------------------------------------   Rd
...----------------TTSGLKAGKST-LNDGGLSIKNPTGSEQIQVGADG   4223
...----------------TQSGLKAGDSTTLNKDGKSIKNPASNEQIQVGADG   LES-1
...                *    ****        *  **   *  *   * *

-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
TLTGLTSITLGGTANGRNDTGTVINKDGLTITLANGAAAGTDASNGNT----ISVTKDGISA...
TLTGLTSITLGGTANGRNDTGTVINKDGLTITLANGAAAGTDASNGNT----ISVTKDGISA...
-------------------------------------------------------------...
VKFAKVNNNGVVGAGIDGTTRITRDEIGFTGTNGSLDKSKPHL------------SLDGINA...
VKFAKVDK-GNSSTGIDGTSRITKDQIGFTGANGSLDTTKPHLTKDKLKVGEVEITNTGINA...
 *        **     *    *  * * * *    *    *         * **  ** *...

...------------------------------   33
...------------------------------   32
...------------------------------   29
...------------------------------   K22
...------------------------------   M4071
...------------------------------   11
```

```
K9      ...----------
HSF     ...GNKEITNVKSA---------LKTYKDTQNTA
API     ...GNKEITNVKSA---------LKTYKDTQNTA
Rd      ...----------
4223    ...GGKKITNIQSGEIAQNSHDAVTGGKIYDLKT
LES-1   ...GGKKITNIQSGDITQNSNDAVTGGRVYDLKT
        ...* * **** ******** *** *   * *

        ----------...
        ----------...
        ----------...
        ----------...
        ----------...
        ----------...
        ----------...
        ----------DE...
        GATQPAANTAEVAKQDLVDLITKPAITGAAGNGADAKAPDTTAATVGDLRGLGAVLSAKKTADE...
        ----------...
        ----------EL...
        ----------EL...
        ----------...
        ...----------...
        ...----------...
        ...----------...
        ...----------...
        ...----------...

33
32
29
K22
```

FIG.28N

FIG.28O

```
...------------------------------          M4071
...------------------------------          11
...------------------------------          K9
...TQDKEFHAAVKNANEVEFVGKNGATVSAKT          HSF
...TQDKEFHAAVKNANEVEFVGKNGATVSAKT          SPI
...------------------------------          Rd
...ENKISSTAKTAQNSLHEFSVADEQGNNFTV          4223
...ESKINSAAKTAQNSLHEFSVADEQGNNFTV          LES-1
...       *   *   **  *  *

-------------------------------------------------------...
-------------------------------------------------------...
-------------------------------------------ISVTKGSFAEVKT...
-------------------------------------------ISVTKGSFAEVKT...
-------------------------------------------------------...
-------------------------------------------------------...
-------------------------------------------------------...
DNNGKHTVTIDVAEAKVGDGLEKDTDGKIKLIVDNTDGNNLLTVDATKGASVAKGEFNAVTT...
DNNGKHTVTIDVAEAKVGDGLEKDTDGKIKLIVDNTDGNNLLTVDATKGASVAKGEFNAVTT...
SNPYSSYDTSKTSDVITFAGENGITTKVNKGVVRVGIDQTKGLTTPKLTVGNNNGKGIVIDS...
SNPYSSYDTSKTSDVITFAGENGITTKVNKGVVRVGIDQTKGLTTPKLTVGNNNGKGIVIDS...
*      *   **    *  *  *    *  *  *  *        * *    *  * *...

...------------------------------------          33
...------------------------------------          32
...DATTGGQVNAD-RGKVK----AEDENGADVDKKV-------          29
```

FIG.28P

```
...DATTGGQVNAD-RGKVK----AEDENGADVDKKV-------          K22
...-----------------------------------------          M4071
...-----------------------------------------          11
...-----------------------------------------          K9
...DATTAQGTNANERGKVVVKGSNGATATETDKKKV-------          HSF
...DATTAQGTNANERGKVVVKGSNGATATETDKKKV-------          API
...QNGQNTITGLSNTLANVINDKGSVRTTEQGNIIKDEDKTRA          Rd
...KDGQNTITGLSNTLANVINDGAGHSLS-QGLAN-DTDKTRA          LES-1
...                          *

                                                                      ...
---------------------------------------------------------------------...
                              INLNIDSSGNAVGSSTITFKAGDNLKIKQSGN...
ATVKDVAKAINDAATFVKVESTDDDIENGAAGKNETTDQALKAGDTLTLKAGKNLKAKLDQN...
ATVKDVAKAINDAATFVKVESTDDDIENGAAGKNETTDQALKAGDTLTLKAGKNLKAKLDQN...
---------------------------------------------------------------------...
---------------------------------------------------------------------...
---------------------------------------------------------------------...
ATVGDVAKAINDAATFVKVEN-DDSATIDDSPTDDGANDALKAGDTLTLKAGKNLKVKRDG-...
ATVGDVAKAINDAATFVKVEN-DDSATIDDSPTDDGANDALKAGDTLTLKAGKNLKVKRDG-...
---------------------------------------------------------------------...
ASIVDVLSAGFNLQGNGEAVDFVSTYDTVNFADGNATTAKVTYDDTSKTSKVVYDVNVDDTT...
ASIGDVLNAGFNLQGNGEAVDFVSTYDTVDFIDGNATTAKVTYDDTSKTSKVVYDVNVDNKT...
*** *      *    *                   *          *
                         ...     170      180      190      200
```

FIG.28Q

```
...-----FALANDLNVKNATVSDKLSLGANGKKVDITSDANG-------      33
...D--FTYS.KKE.KNLTSVETE...F...N.........-------      32
...GKSVT....K..D.TS.K......I.KDIN..........-------    29
...GKSVT....K..D.TS.K......I.KDIN..........-------    K22
...-----.T.EK..................N.......T..-------     M4071
...-----....K..G..T.....T.TI.GGAAAGAT.TPKVNVTSTTDG    11
...-----....K..SMRT.....T.TI.GSTTTGSA.TPKVNVTSTASG    K9
...-KNIT.......S..S..........T..N..N....TK.-------    HSF
...-KNIT.......S..S..........T..N..N....TK.-------    API
...------------------------..N.......T..-------       Rd
...IEVK-DKKLGVKTTTLTSTGTGANKFALSNQATGDALVKASDIVA--    4223
...IEVTSDKKLGVKTTTLTKTSANGNATKFSA-ADGDALVKASDIAT--    LES-1
...                *  *         *       *

          210         220       230       240        250         ...
LKFAKQGT-NGQNGN--VHLNGIASTLDDPRVGGKTAHLTKEISDTERN--RAASVGDVLNA...
..L..T.NG....S.--..........T.TLA.T.G.VDTN.DAVNYH--......Q....S...
..L..T.NG......--..........T.TIT.MT.QASNGVAVQ-NH--......A........
..L..T.NG......--..........T.TIT.MT.QASNGVAVQ-NH--......A........
.....PS.-......--..........T.TIT.TTKSATNGVDVQNH-.--.....A........
.....DAA--.A..DTT......G...T.TK..SPAT.IDGGDQS.HYT--....IK........
.V...GA.GANGDTT--...TN.....Q.TLLNTGVVSKLDGNGITADEKK.....Q....S...
.....DSKT-.DDA.--I.........T.TLLNSGATTNLGGNGITDNEKK.....K........
..x..DSKT-.DDA.--I.........T.TLLNSGATTNLGGNGITDNEKK.....K........
.....P..-......--..............................--.............
```

FIG.28R

```
-----------------...TLSGDIQTAKGASQANNSAGYVDADGNKVIYDSTDNKYYQA...
-----------------...TLSGDIQTAKGASQASSSASYVDADGNKVIYDSTDNKYYQV...
*  ***     **   ***  *** *                    **    *  ...

                     ...260        270       280       290       300
                     ...GMNIRGAK--TIGG-TVDNVDFVSTYDIVEFASGANANVSVTTDDN--     33
                     .......Q.NGNNVDFVR.Y.T....N---------.........A.TAH-     32
                     .......Q.NGASVDFVNAY.T....N---------.T.T..N....TAH-     29
                     .......Q.NGASVDFVNAY.T....N---------.T.T..N....TAH-     K22
                     .......Q.NGAS---------....N.....D.VN.L.T..N....TAHN     M4071
                     .......K.V.AGSTT-GQSE.....H.......L.-.DTETTTV.V.S--     11
                     .......K.V.TGAT---.S......R.......L..SEETTL..V.S---     K9
                     ......V..V.PASANNQ-.E.I...A.....D.V..DKDTT...VES---     HSF
                     ......V..V.PASANNQ-.E.I...A.....D.V..DKDTT...VES---     API
                     ...........--...-..............................--     Rd
                     ...KNDGTVD.TKEVAKDKLVAQAQTPDGTLAQMNVKSVI.KEQVN.A.--     4223
                     ...NDKGQVD.NKEVAKDKLVAQAQTPDGTLAQMNVKSVI.KEQVN.A.--     LES-1
                     ...                            *

       310       320       330       340       350       360 ...
KKTTVRVDVTGLPVQYVTEDSKTVVKVGNEYYEAKQDGSADMDKKV-ENGKLAKTKVKLVSA...
...................G..........K..D......NQ..-...E..............
...................G......D.K................-...E..............
...................G......D.K................-...E..............
...................GE........................-..................
........F......G.........................-K..E.V............
```

TO6TZT"29E9E6GO

FIG.28S

```
.ENGK.TE.KIGAKTS.IKEKDGKLFT.KANK.TNKVDG.NATEDA-DE..GLV.AKDVID....
ESNGKSTK.KIGAKTSGIKEKDGKLFT.KANKDTN.VASNNAADDT-DE..GLV.AETVIN....
.DNGK.TE.KIGAKTS.IK.HNGKLFT.K.LKD.NNN.VTVTETDGKDE.NGLV.AKAVID....
.DNGK.TE.KIGAKTS.IK.HNGKLFT.K.LKD.NNN.VTVTETDGKDE.NGLV.AKAVID....
.........................................-.................
..QGINEDNAFVKGLEKAASDNKTKNAAVTVGDLNAVAQTPLTFAG-DT.TT..KLGETLTI...
..QGINEDNAFIKGLENAAKDTKTKNAAVTVGDLNAVAQTPLTFAG-DT.TT..KLGETLTI...
** *                                          *          *    ...

                    ...      370       380       390       400
                    ...NGTNPVKISNVADGTEDTDAVSFKQLKALQDKQVTLSAS     33
                    ...S.................................T.     32
                    ...S.Q........E...EN...........E.....T..    29
                    ...S.Q........E...EN...........E.....T..    K22
                    ..................N.....................    M4071
                    ..............E...............N.......     12
                    ...VNKTGWR.KTTDANGQNG.---FATVASGTNVTF---..  11
                    ...VNKAGWR.KTTGANNQAGQ---FETVTSGTNVTF---.D  K9
                    ...VNKAGWRVKTTGANGQND.---FATVASGTNVTF---.D  HSF
                    ...VNKAGWRVKTTGANGQND.---FATVASGTNVTF---.D  API
                    .......................................     Rd
                    ...KGGQTDTNKLTDNNIGVVAGTDGFTV.LAK.LTNLN.VN  4223
                    ...KGGQTDTNKLTDNNIGVVAGTDGFTV.LAK.LTNLN.VN  LESS-1
                    ...                                *    *

      410       420       430       440       450       460 ...
```

FIG.28T

```
NAYANGGSDADGGKATQTLGNDLNFKFKSTDSELLNIKAAGDTVTFTPKKGSVQVGDDGKAT...
.....T.N.....S.G.....S.G...K.S.T.....S...
.....N.....N.G.....G.....VEN.....E.....
.....N.....N.G.....G.....VEN.....E.....
.....GI...S.G.....G.....EN.....
.....V..V.....S.G.....G.....DK....I.----------...
GNGTTATVTNG-TDGITVKYDAKVGDGLKLDGD-KIAADTTALTVNDGKNANNPKGKVADVA...
GNGTTAVVTGDATNGITVKYEAKVGDGLKIGNDQKITADTTALTVTGGK---------VTAPD...
GNGTTAEVTKANDGSITVKYNVKVADGLKLDGD-KIVADTTVLTVADGK---------VTAPN...
GNGTTAEVTKANDGSITVKYNVKVADGLKLDGD-KIVADTTVLTVADGK---------VTAPN...
.....G....S.G.....G.....EN.....
AGGTKIDDKGVSF----------
AGGTRIDEKGISFVDANGQAKANTPVLSANGLDLGGKRISNIGAAVDDNDAVNFKQFNEVAK...
                    *                   *
...      470       480       490       500
...IQDGAKTTTGLVEASELVDSLNKLGWKVGVGKDGTG--AT
....SK..N..E.....E.....E.V.S.---EL
.....N.T...D.....E.....D...S.---EL
.....N.T...D.....E.....D...S.---E.
.....T.T.....V.---
...----------
....STDEKK-----.T.KG..TA..S.S.TTTAAEADG.---TL
...ATNGKK-----.N..G.A.A....S.TAK-AEADTANGGEL
...NGDGKK----F.D..G.A.A....S.TATA..E...---EV
...NGDGKK---F.D..G.A.A....S.TATA..E...---EV
```

FIG.28U

```
..........................................---..          Rd
...-------------------------------------------           4223
...TVNNLNNQSNSGASLPFVVTDANGKPIN.TDGKPQKAIKGA              LES-1
...                *      *

         510       520       530       540       550       560 ...
DGTHTD-TLVKSGDKVTLKAGDNLKVKQEGTNFTYVLRDELTGVKSVEFKDTENGANGASTK...
...SKE-..........................A.K.............A............
..ASNE-..............E......D......A.K.............A..S.........
..ASNE-..............E......D......A.K.............A..S.........
......-..........................A.K....D.........A............
----------------------------------------------------------------...
..NASE-QE..A.....F...K........A....S.Q.A...LT.ITLGTGN...K---.E...
...ADE-KE..A.ET..F...K........A....S.Q.A...LT.ITLGTGN...K---.E...
.PANSAGQE..A.....F.......I..S.KD...S.KK..KDLT......ANG.TGSE......
.PANSAGQE..A.....F.......I..S.KD...S.KK..KDLT......ANG.TGSE......
......-.........................................................
----------------------------------------------------------------...
..KYYH-----------------------------------------------..ANGVP...
**                                                    * * *    ...
                          ...    570       580       590       600
                          ...ITKDGLTITPAND-ANGAAATDADKIK---VASDGISAGNKAV     33
                          ............L..G-....TV.......---..............   32
                          ............S..G-.............---..............   29
                          ............S..G-.............---..............   K22
```

FIG.28V

```
                                                                    M4071
.....G-.GA.G.NT.NT.S--.TK.....                                      12
...-------R.SG-.....-----.....                                      11
.....N.....G-.---G.NN.NT.S--.TK.....DQS.                           K9
.....N.....G-----G.NN.NT.S--.TK.....DQS.                           HSF
.....G-.GA.G.NT.NT.S--.TK.....                                     API
.....G-.GA.G.NT.NT,S--.TK.....                                     Rd
.....F....G-.....--.....R.....                                     4223
...-------------------------------------------------------------   LES-1
...VD...KP..D.DKL..L..HGKPLDAGHQV...L.-GNSD-.I
...* *** ** * * **          ** * * * * **
...
      610       620       630       640       650       660    ...
KNVVSGLKKFGDANFNPLTSSADNLTKQYDNAYKGLITNLDEKSKGKQTPTVADNTAATVGDL...
-------------------------------------------------------------------...
.....D.....N.D.....GTD...V.....
.....D.....GAD..L.....
.....D.....GAD..L.....
.....D.....GAD..L.....
.....D.....GAD..L.....
.....D.....
.....
-------------------------------------------------------------------...
.....D.....N.D.....GTD...V.....
.....D.....GAD..L.....
.....D.....GAD..L.....
T.....GHTLANGTV..FE-.H.....D.....GADNN-.....
T.....GHTLANGTV..FE-.H.....XD.....GADNN-.....
-------------------------------------------------------------------...
-------------------------------------------------------------------...
----------TLTNTIKSTLP.I.TPMT.NA.AGQAQSLPSLSAAQQSN..S.K.V...
```

FIG.28W

```
       *         *       **  *          *   ****  **...
                     ...    670        680       690       700
                     ...TGLGWVISADKTTGES-KEYSAQVRNANEVKFKSGNGIN        33
                     ...---------------------------------------        32
                     ..................LN..N..................H        29
                     ..................LN..N..................H        K22
                     ...............K..LN..N...................        M4071
                     ...---------------------------------------        12
                     .................G.-T..HD.................        11
                     ..................LD..N...................        K9
                     ..................PNQ.N...................        HSF
                     ..................PNQ.N...................        API
                     ...---------------------------------------        Rd
                     ...---------------------------------------        4223
                     ...LNV.FNLQTNHNQVDFV.A.DTVNFVNGTGADITSVRSA        LES-1
                     ...  *** * **          *            **

      710       720       730       740       750       760 ...
VSGKTLDNGTREITFELAKDENAIAFGSGSKALRDNTVAIGTGNVVNAEKSGAFGDPNYIED...
--------------------------------------------------------------...
-----V-..R...............Y....................................
-----V-..R...............Y....................................
..............................................................
--------------------------------------------------------------...
.....V-..R........G.------------------------------------------...
```

FIG.28X

```
.....V-..R........G.------------------------------------------...
......-....V......G.------------------------------------------...
......-....V......G.------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
DGTMSNITVNTALAATDDDGNVL.KAKD.KFYKA.DLMPN.SLKAGKSASDAKTPTGLSLVN...
 ** *      **     *  *         ** *  **     *   *        * *...
...    770      780       790      800
...KAGGSYAFGNDNRITSKNTFVLGNGVNAKYKANGKVDT-----        33
...----------------------------------------------     32
..............................................        29
..............................................        K22
...........................S...RD...N.L.EE---         M4071
...----------------------------------------------     12
...----------------------------------------------     11
...----------------------------------------------     K9
...----------------------------------------------     HSF
...----------------------------------------------     API
...----------------------------------------------     Rd
...----------------------------------------------     4223
...PNA.KGST.DAVALNNLSKA.FKSKDGTTTTTVSSDGISIQGK        LES-1
...  **  * **   *      *      *   * *

---------------------------------------------------------------...
---------------------------------------------------------------...
```

FIG.28Y

```
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
VVKSNEFTVKETNGKETSLVKVGDLYYSKEDIDLTTGQPKLKDGNIVAAKYQDKGGKVVS-V...
VVKSNEFTVKETNGKETSLVKVGDLYYSKEDIDPATGKPKVTNGNAVAAKYQDKDGKVVSAD...
VVKSNEFTVKNADGSETNLVKVGDLYYSKEDIDPATSKPMTGKTE----KYKVENGKVVSAN...
VVKSNEFTVKNADGSETNLVKVGDLYYSKEDIDPATSKPMTGKTE----KYKVENGKVVSAN...
-------------------------------------------------------------...
VDSSGQAKANTPVLSANGLDLGGKVISNVGKGTKDTDAANVQQLNEVRNLLGLGNAGNDNAD...
DNSSI-------TLSKDGLNVGGKVISNVGKGTKDTDAANVQQLNEVRNLLGLGNAGNDNAD...
  * *           *   *           *       * *        *    **...

...-------------------------------------        33
...-------------------------------------        32
...-------------------------------------        29
...-------------------------------------        K22
...-------------------------------------        M4071
...-------------------------------------        12
...TDNTEATITNKGSGYVTGNQ-----------------        11
...GSSNTAVTLTNKGYGYVTGNQ----------------        K9
...GSK-TEVTLTMKGSGYVTGNQ----------------        HSF
...GSK-TEVTLTMKGSGYVTGNQ----------------        API
...-------------------------------------        Rd
...GNQVNIADIKKDPNSGSSSNRTVIKAGTVLGGKGNNDT       4223
...GNQVNIADIKKDPNSGSSSNRTVIKAGTVLGGKGNNDT       LES-1
```

09936362.121901

FIG.28Z

```
                  ...        *        ***

--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
VADAIAKSGFEKGKADEADAKRAFDD--KTKALSAGTTE-IVNAHDKVRFANGLNTKVSAAT...
VADAIAKSGFEKGKADAEKAKAAFGD--ETKALSSDKLE-TVNANDKVRFANGLNTKVSAAT...
VADAIAKSGFEKGKADAAEAEKAFAESAKDKQLSKDKAE-TVNAHDKVRFANGLNTKVSAAT...
VADAIAKSGFEKGKADAAEAEKAFAESAKDKQLSKDKAE-TVNAHDKVRFANGLNTKVSAAT...
--------------------------------------------------------------...
EKLATGGIQVGVDKDGNANGDLSNVWVKTQKDGSKKALLATYNAAGQTNYLTNNPAEAIDRI...
EKLATGGVQVGVDKDGNANGDLSNVWVKTQKDGSKKALLATYNAAGQTNYLTNNPAEAIDRI...
  **    *       * *      * *     * **    *     *              ...

...-------------------------------------------   33
...-------------------------------------------   32
...-------------------------------------------   29
...-------------------------------------------   K22
...-------------------------------------------   M4071
...-------------------------------------------   12
...VESTDANGDKVTTTFVKTDVELPLTQIYNTDANGKKITKVV     11
...VESTDANGDKVTTTFVKTDVELPLTQIYNTDANGKKI---V     K9
...VESTDANGDKVTTTFVKTDVELPLTQIYNTDANGNKI---V     HSF
```

FIG.28A'

```
...VESTDANGDKVTTTFVKTDVELPLTQIYNTDANGNKI---V    API
...-----------------------------------------    Rd
...NEQGIRFFHVNDGNQEPVVQGRNGIDSSASGKHSVAIGFQ-    4223
...NEQGIRFFHVNDGNQEPVVQGRNGIDSSASGKHSVAIGFQ-    LES-1
...  * *       *            *   *   *  **

-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
-------------------------------------------------------------...
KDGQTKWYELNADGTADMTKEVTLGNVDSDGKKVVKDNDG---KWYHAKADGTADKTKGEVD...
KNGD-KWYYTKDDGSTDMTKEVTLGNVDSDGKKVVKEDN----KWYGVKSDGSTDKTQVVEE...
KKADGKWYELNADGTASN-KEVTLGNVDANGKKVVKVTENGADKWYYTNADGAADKTKGEVS...
KKADGKWYELNADGTASN-KEVTLGNVDANGKKVVKVTENGADKWYYTNADGAADKTKGEVS...
-------------------------------------------------------------...
AKADGEAAVAIGRQTQAGNQSIAIGDNAQATGDQSIAIGTGNVVAGKHSGAIGDPSTVKADN...
AKADGEAAVAIGRQTQAGNQSIAIGDNAQATGDQSIAIGTGNVVTGKHSGAIGDPSTVKADN...
  **       *      *****    *        *       * *  *            ...

...--------------------------    33
...--------------------------    32
...--------------------------    29
...--------------------------    K22
...--------------------------    M4071
```

FIG.28B'

```
                                   ...---------------------------          12
                                   ...NDKVSTDEKHVVSLDPNDQSKGKGVV           11
                                   ...A-KVSTDEKHVVSLDPNDQSKGKGVV           K9
                                   ...NDKVSTDEKHVVSLDPNDQSKGKGVV           HSF
                                   ...NDKVSTDEKHVVSLDPNDQSKGKGVV           API
                                   ...---------------------------          Rd
                                   ...SYSVGNNNQGTDATQTDVFGVGNNIT           4223
                                   ...SYSVGNNNQGTDATQTDVFGVGNNIT           LES-1
                                   ...    ** **      * *   *.*   *

       810       820       830       840       850       860...
ETVTVKDKDGKETTVTVPKALGATVENSVYLGNKSTATKDKGKNLKSDGTAGNTTTAGTTGT...
--------------------------------------------------------------...
..................................................................
..................................................................
.EKE.VG..AK.K...Q...E..........A......................A.....
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
--------------------------------------------------------------...
VTESNSVAL.SNSAISAGTHA.TQAK-------------------.......T.....A......
VTESNSVAL.SNSAISAGTHA.TQAK-------------------.......T.....A......
         *  * **     *                        ******* *********...

                                   ...   870       880       890       900
                                   ...VNGFAGATAHGAVSVGASGEERRIQNVAAGEISATSTD     33
                                   ...-----------------------K............       32
                                   ........................................     29
```

FIG.28C'

```
...................................................    K22
...................................................    M4071
...-----------------------------------.............    12
...------------------------------.D...N.D.......       11
...------------------------------.N.M.N.........       K9
...------------------------------.D...N.........       HSF
...------------------------------.D...N.........       API
...------------------------------K.............        Rd
....K....Q..V.........A...........V.....               4223
....K....Q..V.........A...........V.....               LES-1
...* **** ** ********* **** *** *********
```

```
        910       920              930       940       950      ...
AINGSQLYAVAKGVINLAGQVN-------KVGKRADAGTASALAASQLPQASMSGKSMVSIA...
....................NLEGKVN....................T.P...........
....................-------....................P...........
....................-------....................P...........
....................-------....................P...........
....................-------....................P...........
....................NLEGKVN....................T.P....A.....
....................NLEGKVN....................T.P...........
....................NLEGKVN....................T.P....A.....
....................NLEGKVN....................T.P....A.....
....................-------....................P...........
.V......---.ATQSI.NAT.ELDHRIHQNENK.N..IS..M.MASM...YIP.R...TGG...
.V......---.ATQGI.NAT.ELDHRIHQNENK.N..IS..M.MASM...YIP.R...TGG...
********    **    **    *          ***** ***** * ****    ****** *...
```

FIG.28D'

```
... 960        970        980        990        1000
...GSSYQGQSGLAIGVSRISDNGKVIIRLSGITNSQGKTGVAAGVGYQW*      33
.........N.....................................*      32
.........N.....................................*      29
.........N.....................................*      K22
.....................................*      M4071
.....................L.....................*      12
.........N.....................................*      11
.........N.....................................*      K9
.........N.....................................*      HSF
.........N.....................................*      API
.....................................*      Rd
...IATHN..GAV.V.L.KL....QWVFKIN.SADT..HV.A.V.A.FHF*      4223
...IATHN..GAV.V.L.KL....QWVFKIN.SADT..HV.A.V.A.FHF*      LES-1
... ****** *************  * ** *******  * * * ** *
```

FIG.29

Oligonucleotides primers to PCR amplify truncated strain 11 S44 hia gene.

```
                Nde I
                  M  S44A  T  V  E  A  N  N  N  T
5'    GGGAATTCATATGTCCGCAACGGTTGAGGCGAACAACAATACT    3'        6817.SL    SEQ ID NO:56
                                                                          SEQ ID NO:55

                                    Sty I
       H  T  I  T  F  A  L  A  K  D  L  G
       CACACCATTACCTTTGCTTTAGCGAAAGACCTTGGT                               SEQ ID NO:59
                                                                          SEQ ID NO:58
3'     GTGTGGTAATGGAAACGAAATCGCTTTCTGGAACCACCCTAGGGC  5'        6818.SL    SEQ ID NO:57
```

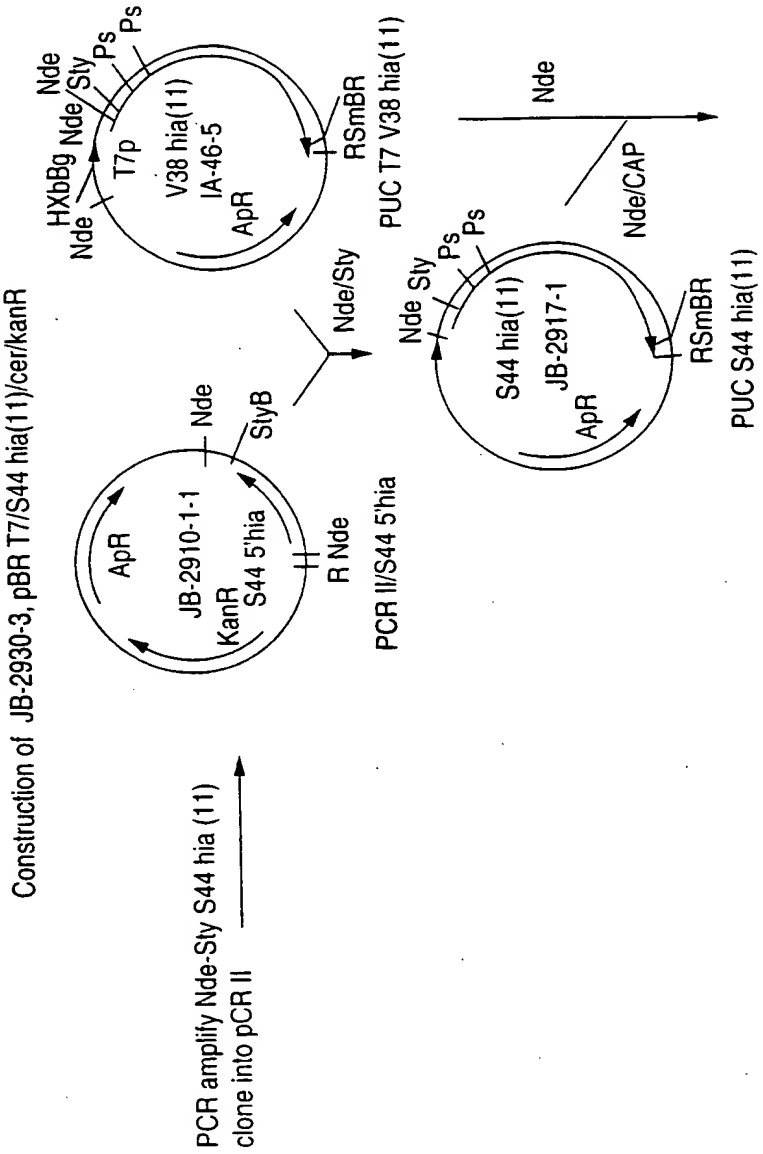

Construction of JB-2930-3, pBR T7/S44 hia(11)/cer/kanR
PCR amplify Nde-Sty S44 hia (11)
clone into pCR II
JB-2910-1-1
ApR
KanR
S44 5'hia
Nde
StyB
R Nde
PCR II/S44 5'hia
Nde/Sty
HXbBg
Nde
Nde
Sty
Ps
Ps
T7p
V38 hia(11)
IA-46-5
ApR
RSmBR
PUC T7 V38 hia(11)
Nde
Nde/CAP
Nde Sty
Ps
Ps
S44 hia(11)
JB-2917-1
ApR
RSmBR
PUC S44 hia(11)

FIG.30A

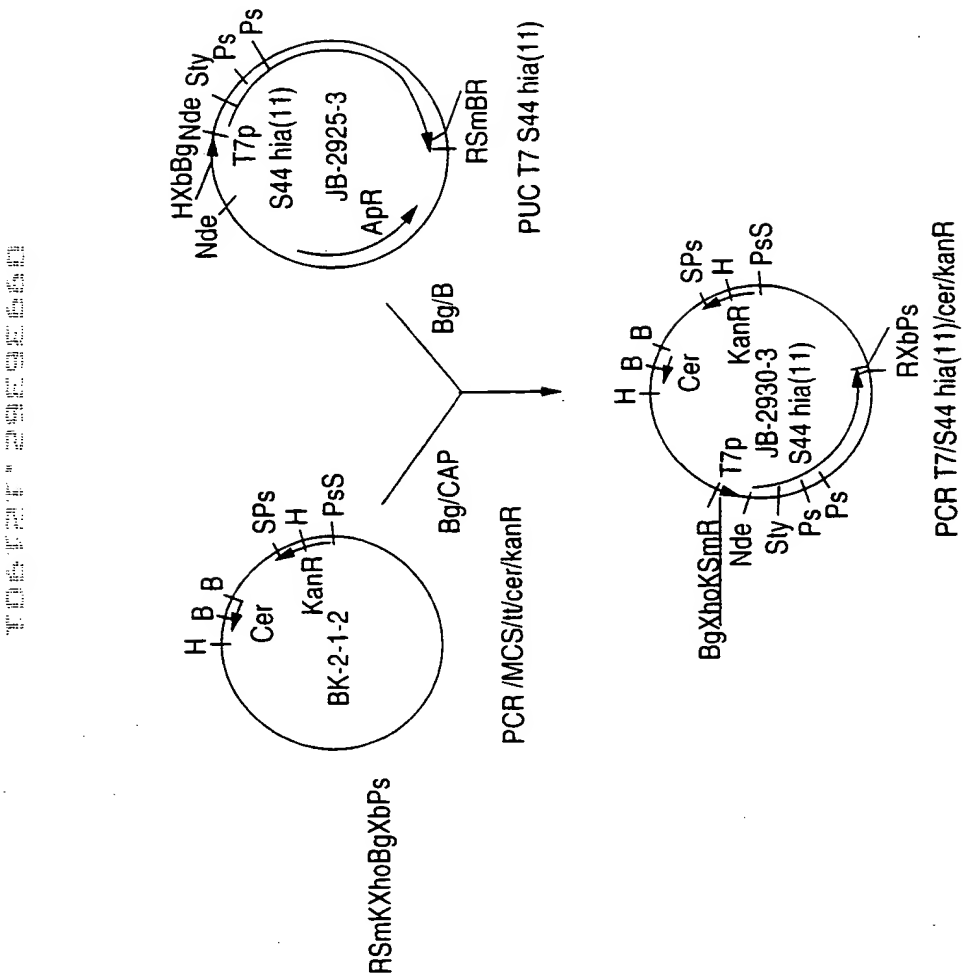
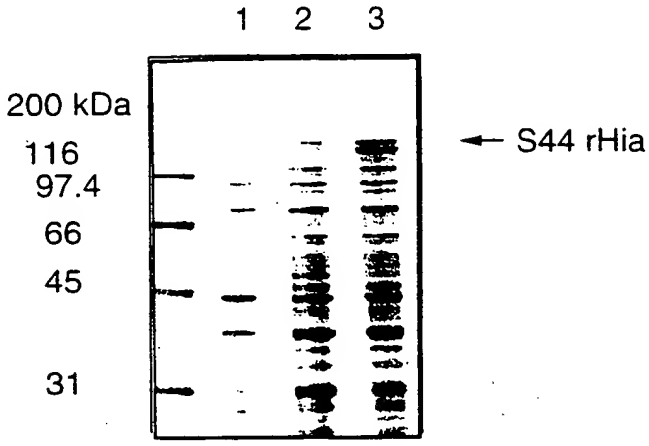

HXbBg
Nde
Nde
Sty
Ps
Ps
T7p
S44 hia(11)
JB-2925-3
ApR
RSmBR
PUC T7 S44 hia(11)
Bg/B
Bg/CAP
PCR /MCS/tt/cer/kanR
H
B
B
Cer
SPs
H
KanR
PsS
BK-2-1-2
RSmKXhoBgXbPs
BgXhoKSmR
Nde
Sty
Ps
Ps
T7p
JB-2930-3
S44 hia(11)
RXbPs
PCR T7/S44 hia(11)/cer/kanR

FIG.30B

Production of S44 rHia from different vectors



1. pET S44 hia t_0
2. pET S44 hia t_4
3. pBR T7 S44 hia/cer/kanR t_4

FIG.31

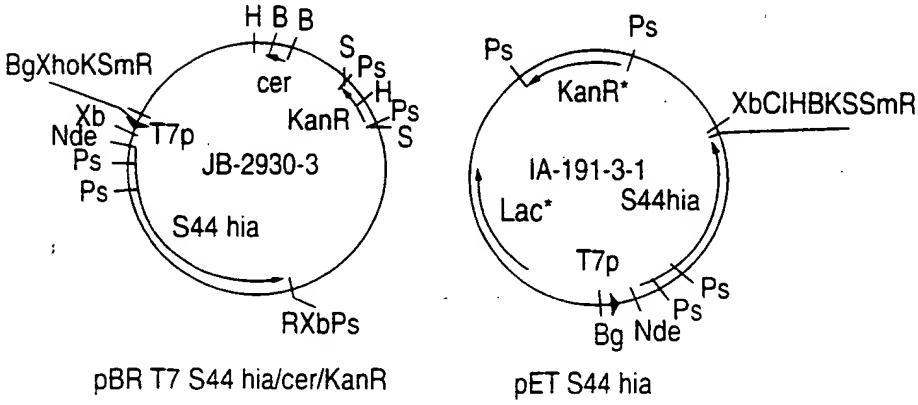


FIG.32